THE PSYCHOLOGY OF INDIVIDUAL DIFFERENCES

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BY

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PREFACE

For a number of years the writer has given courses on the psychology of individual differences to students in liberal arts and in education who wished to obtain a general knowledge of individual differences without the necessity of taking several courses in statistics and mental measurement. This volume is directly the outgrowth of that experience. It aims to give, especially for the benefit of the elementary student, an introduction to the problems, the methods, the results, and the applications of the psychology of individual differences. The point of view is essentially biological, experimental, and statistical, and but little attention has been given to pathology and psychoanalysis. Individual differences in acquired traits are discussed to some extent, but the field primarily considered is differences in native traits. Differences in acquired traits are held to be of interest chiefly to the educational psychologist and the social psychologist.

In general it is to be supposed that the study of individual differences will not be undertaken until after a course in elementary psychology, but as such courses are very variable both in method and in content, the intention here has been to assume but little previous technical knowledge on the part of the reader. This principle has rendered it necessary to digress from the primary problem and to present the elements of statistics, mental measurement, and the mechanics of inheritance and variation as well as certain things in elementary psychology, physiology, and neurology. The first part of the book is largely taken up with such material. The only apology offered

for these digressions is that the writer's experience has convinced him of their necessity for a proper understanding of the subject. Due, however, to the numerous fields from which it has seemed necessary to borrow material, the writer has probably made some errors, and if so, he will welcome corrections.

Some, of course, will question the wisdom of teaching the psychology of individual differences to students who have not already had a thorough grounding in biology and psychology. In point of fact, however, we are today teaching individual differences in applied psychology, in business psychology, in educational psychology, in social psychology, and even in elementary psychology, and this is almost invariably done without supplying an adequate foundation for the understanding of the material presented. To restrict the study of the subject only to those who already have adequate training in neurology, physiology, genetics, general psychology, statistics, and mental measurement would be in effect to rule the course out of the college curriculum. In view, therefore, of the increasing interest in the subject and of its intrinsic importance it seems to the writer that the better plan is to supply the necessary foundation material as a preliminary part of the discussion of the subject itself, just as we regularly teach a little neurology as a foundation for elementary psychology. This has a further justification in that it makes it possible for teachers and other intelligent readers to acquire a fair understanding of the subject without the necessity of studying it in a college course.

The method of presenting the material has been influenced primarily by the desire to make it interesting and intelligible to readers of average college ability. For this reason, and also for the sake of greater brevity, few tables have been presented and few footnote references have been given to the sources on which statements are based. The more critical students may find these aspects of the treat-

ment less satisfactory. For such students, however, if time and library facilities permit, extensive reading of the original articles is much to be desired. References to many of these are given at the end of each chapter, but no attempt has been made to give a complete bibliography of these topics. The student in search of further references should consult the bibliographies in the references given, especially those at the end of Chapter I, and, of course, the *Psychological Index.*

The final part of the book, dealing with applications, is in the nature of the case only a suggestion of some of the more important possibilities; to make such a treatment at all comprehensive would be beyond the scope of the present volume.

Most of the material presented has quite naturally been borrowed from others, but considering the purpose of the book no attempt has been made to acknowledge this debt in detail. However, the writer's obligations to Galton, Pearson, Cattell, Thorndike, Binet, Terman, and Davenport are especially heavy and are gladly acknowledged here.

R. S. E.

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CHAPTER I

THE PROBLEMS AND METHODS OF INDIVIDUAL PSYCHOLOGY[1]

Relation to General Psychology

The psychology most commonly taught in the schools is the psychology of the average or normal human adult. This psychology of the normal adult, usually called *general psychology,* pays but little attention to differences between individuals: its problems relate to the aspects of consciousness or of behavior common to mankind as a whole, and it attempts to analyze consciousness or behavior and find the general characteristics and laws of mind. In the study of memory, for example, general psychology attempts to describe the characteristics of memory and to give the laws of learning. The student learns that it is more economical to memorize a passage by reading it through as a whole many times until it is memorized than to memorize it sentence by sentence. He learns also to distribute the learning periods over several days, or over an even longer period, if permanent results are desired. But he does not learn from a study of general psychology just how

[1] Several different names have been used for this branch of psychology. "Individual psychology" was used by Binet and has been used more recently by Adler for a psychoanalytic treatment of differences. "Differential psychology" was used by Stern. "Psychology of individual differences" was used by Thorndike. "Variational psychology" is at times used, as is also "type psychology," though this latter term is not appropriate.

uniform or how variable the memory capacities of different individuals are. He does not learn how the memory of the average child of ten years compares with the memory of the average man of thirty. It is thus entirely possible, and in fact it often happens, that the student who has completed a course in elementary psychology has very erroneous ideas as to the variability of capacities and tendencies in the general population. In the study of the *psychology of individual differences,* on the other hand, the problem is to discover the nature and extent of these and other differences in mental traits. The results of general psychology are assumed as a foundation, and the attempt is made to describe and explain the variations in different traits between individuals.

THE PROBLEMS OF INDIVIDUAL PSYCHOLOGY

Systems of Character Analysis

In connection with the question of the nature and extent of individual differences there has naturally arisen a variety of systems or methods for determining or predicting these differences. Among these may be mentioned astrology, clairvoyance, palmistry, graphology, phrenology, and physiognomy. The first of these may be waved aside as unworthy of serious consideration; the latter ones, however, are given credence by intelligent people to such a degree that it will be necessary to examine their foundation. To what extent can we determine a person's mental characteristics from a study of his stature, weight, color of skin, hair, or eyes, shape or size of head, or from the characteristics of his nose, ears, or other features? In order to clear up this general problem, we shall consider some facts of physiological psychology concerning the relations of mind and body. This will include a discussion of the effects of digestion, glandular secretions, and nerve and brain activity on the mental

life of the individual. After such a study we can evaluate more accurately such systems as phrenology and palmistry.

Analysis of the Individual

An individual is extremely complex, and, before we can get very far in studying individual differences, it will be necessary to analyze mental traits into various kinds of capacities, tendencies, etc., so that we shall have a basis for discussion. Closely connected with this problem is that of how different traits are combined and related in an individual. Does a good memory go with good reasoning power? Do strong emotions go with great intellectual ability? Does a blind man have better than average hearing? This latter problem as to the relations existing between different traits will be deferred until near the end of the book, but the analysis of the individual will be considered in an early chapter.

Measurement of Mental Traits

Science is largely based on measurements; hence, if we are to consider individual differences in a scientific manner, we must devote some attention to the problem of how mental traits are measured. In this connection we must also consider the statistical treatment of the results of mental measurements, because large groups of measurements require statistical treatment as a basis of interpretation.

The Causes of Individual Differences

From such problems we shall turn to a consideration of the causes of individual differences.

Hereditary and Environmental Forces.—In general we may say that all differences must result from the action of hereditary and environmental forces. But in what way and to what extent are differences determined by one rather

than by the other? Is mental deficiency generally due primarily to the action of environmental forces such as disease, alcoholism, and blows on the head, or can it be explained in most cases by heredity? Here again we must digress to some extent and turn to biology for results on which to base our conclusions.

Age, Sex, and Race Differences.—Among the evident biological differences in individuals are those of age, sex, and race. Clearly there are some important physical differences between these groups, but what are the mental differences?

Extreme Deviations in Mental Traits.—There are many interesting groups of individuals, such as the people of genius, the mental defectives, the insane, and the criminals. How do these compare with the normal? How shall we explain in terms of individual psychology the mental make-up of a man of genius? How may we reduce the number of insane, feeble-minded, and criminal? To answer such questions we must first understand the causes of these conditions.

Applications

Finally, we shall consider the practical and theoretical applications of the study of individual differences to various phases of human activity, such as education, government, and business. There are many interesting and important applications of individual differences in these and other fields and some of these will be explained.

SCIENTIFIC METHOD IN INDIVIDUAL PSYCHOLOGY

The Need for Scientific Attitudes and Methods

At the present time we find the greatest diversity of opinions even among intelligent people on the problems of individual differences. Some believe that all are born with

equal mental capacity and that all differences found in adults are due to various diseases, differences in nutrition, differences in work, or other non-hereditary factors. Most races are likely to make some claims to superiority over other races. Men claim to be superior to women, and women often return the compliment with added elements. These beliefs in fundamental equality or in fundamental differences are rarely based on sound evidence: they belong rather to the non-rational prejudices of the holder. And being non-rational prejudices they are very often practically immune to the effects of evidence.

The general existence of such non-rational beliefs presents a serious difficulty to the development of a scientific psychology of individual differences. The field must often be cleared of false presuppositions before a place can be found for correct ideas. Due also to the great complexity of the problems to be studied, many conclusions are possible if different phases of the problem happen to be studied by different people. Thus, people with different experiences reach different conclusions simply because of the limitations of their knowledge.

The only hope of overcoming these differences of opinion must lie in the adoption of scientific methods and attitudes as a preliminary to further study. And since a general understanding on these points cannot be assumed, the remaining part of this chapter will be devoted to a discussion of the fundamental characteristics of science. In this connection we shall also consider some of the special methods used in the study of individual differences, and we shall point out some of the particular dangers which the student of individual differences needs especially to prepare to meet. At present, however, our main problem is the development of the proper general point of view. In a later chapter on tests and statistics we shall discuss in more detail the specific problems of scientific method in connec-

tion with the study of individual differences in mental traits.

The Nature of Science

A science is a body of *organized knowledge.* It must consist of real knowledge as opposed to opinion, superstition, or belief. And the knowledge must be in systematic form. There are then two more or less distinct problems in scientific method: the accurate determination of facts, and the organization of these facts into a coherent system. Let us consider each of these problems in turn.

The Determination of Scientific Facts

Observation and Perception.—The facts on which a science is based are determined by observation. We examine things by means of the eyes, ears, and other senses, and after we have experienced the thing in that way we may attempt to describe what we have perceived. Common sense is inclined to hold that perception is a very accurate process and that what is seen or heard must be true; the sleight-of-hand artist, the psychologist, and the psychiatrist, however, know better. Our perceptions of things are by no means amazingly accurate. A considerable part of what we think we see is inferred, and a fairly large amount of it is often falsely inferred. This has been demonstrated in a convincing way by a number of investigators, notably by Stern. It is found that when a number of individuals observe the same event or series of events their accounts of what has happened do not agree. From the results of such studies we are led to the conclusion that from 10 to 30 per cent of the details of the accounts of ordinary observations are not correct. Under conditions of emotional excitement the error may be much greater and the account may even have little relation to the actual events. Examples of erroneous reports about ordinary events are familiar to

all. Neighborhood gossip often distorts a simple event into something entirely different. Every teacher is familiar with the fact that the members of his classes get very different ideas as to what he says. In view of this situation it becomes quite impossible to base a science on the rumors, the anecdotal gossip, and even the direct observations of untrained individuals.

Causes of Error in Observation.—An analysis of the causes of error in observation shows that a considerable part of it is due to presuppositions, prejudices, or mental bias of some sort. This fact was clearly pointed out by Francis Bacon (1561-1626). In order to observe accurately, Bacon tells us, we must get rid of certain "idols." These idols are of four main types: "Idols of the Tribe," or presuppositions and tendencies common to nearly all men; "Idols of the Cave," or prejudices and false notions peculiar to the individual because of the limitations of his particular experiences; "Idols of the Forum," or those arising largely from misunderstandings or language in social communication; and "Idols of the Theater," or those arising from the acceptance of philosophical and theological systems from the supposed wise men. These systems, be it noted, are likely to be interpreted in vastly different ways by different individuals because of the Idols of the Cave.

Objective versus Subjective Methods.—The success of science has been due in large measure to the emphasis which it has placed on the securing of objective data and on the elimination as far as possible of subjective and personal factors. Those fields of knowledge which were most readily treated by objective methods and which were less closely connected with human emotions became sciences first. From these we have gradually advanced to the more subjective and social subjects. First came mathematics, then physics, then chemistry, then biology, then psychology,

and now sociology and education are in the process of becoming sciences.

An excellent example of the effect of personal and subjective factors is found in the relatively recent studies made on the grading of examination papers by different teachers. Not so long ago teachers' marks were looked upon with considerable veneration and respect. However, when skeptical investigators asked a number of teachers to mark the same paper, it was found that they did not agree. In the well-known case of the geometry paper the marks ranged from 28 to 92. Such experiments have made it clear that a statement to the effect that John made 75 on his geometry (or other) examination is a fact of questionable significance. The uses of such "facts" in science are strictly limited. Success in the grading of papers demands the elimination of personal opinion and the adoption of objective standards. Likewise, success in the study of individual differences demands that our conclusions be based as far as possible on facts determined in a critical and objective manner. At the same time it would be very unwise to refuse to consider any evidence except that obtained in a perfectly satisfactory manner. It has not yet been possible to study some problems objectively and in such cases it is quite as unscientific to ignore the available evidence because it is not objective as it is to use uncertain data when better evidence is available.

Experiment.—One of the most important factors in scientific progress has been the adoption of *experimental methods.* An experiment is an attempt to isolate and control certain aspects of nature so that they can be observed without the distracting and modifying influences of other factors. The experimentalist attempts to control all conditions so that there will be only *one variable* the action of which is unknown. Much false thinking is due to failure to adhere to this principle. It often happens that sev-

eral variables are present and under such conditions effects are quite likely to be ascribed to other than the real causes. Because of the complex phenomena that must often be dealt with in psychology, much error results and the greatest care must be used to overcome the difficulty. And in those cases where it is impossible to have only one unknown variable, we must be correspondingly careful in our conclusions.

Neglected Aspects of Problems.—The logicians point out a cause of much incorrect thinking in what is known as the fallacy of *the neglected aspect.* Early students of certain diseases considered them to be due to hot weather or excessive rain—neglecting the activities of the fly or the mosquito in spreading the bacteria. Neglected aspects of problems often hide variable agencies that must be understood before the problem can be solved. Experiment has often been the only way out of this difficulty, and where experiment is not possible the problem may remain unsolved.

The Methods of Individual Psychology.—In general psychology and in individual psychology discoveries have had to wait until the necessary methods and instruments had been evolved. Individual psychology uses the results obtained by the experimental methods of general psychology. In addition it uses group experiments, known as *tests,* and for the sake of brevity and clearness it treats its results by statistical methods.

Usage is not uniform in the use of the word "tests" but it has come to be applied especially to exercises given under controlled conditions to a group of individuals. Thus we speak of educational tests, meaning tests in arithmetic, spelling, grammar, etc. These have been standardized so that they are fairly accurate instruments for measuring the abilities of a class in those subjects. And we speak of mental tests, including here forms both for individuals

and for groups. The Army Alpha is an example of a group mental test, though many others very much like it have since been placed on the market.

Statistical methods make it possible to describe in an objective way the results of the measurements of a group. Our present conception of the psychology of individual differences requires at least an elementary knowledge of statistical terms and for that reason part of a later chapter will supply a brief explanation of them.

The Organization of Scientific Facts

When the facts of a science are determined, there remains the problem of organizing them into a logical system. Organization was pointed out as the second essential of science.

Classification.—The importance of organization and classification is readily seen in such a science as zoölogy where all animals are grouped into varieties, species, genera, etc. The zoölogist groups all of those animals having certain common characteristics and calls them a species. It must be recognized, however, that such a classification is a product of the mind and is not necessarily a natural one in the sense of existing in nature. As a matter of fact, many classifications are in the course of time rejected because it is seen that they do not fit the facts of nature. Individual psychology suffers because many classifications of human characteristics have grown up without any adequate basis of fact, as, for example, the classification of temperaments into the sanguine, the melancholic, the choleric, and the phlegmatic. As will be shown in later chapters, men cannot be so classified if we adhere to the facts. It is, then, very important that classifications be made with due regard to the dangers of reading into natural phenomena things that exist only in the mind of the observer.

Definition.—In connection with the above discussion of classification some attention needs to be given to definitions. Much needless and futile discussion is engaged in even by professional scientists over definitions. There is really little to be gained by argument over a definition. If the definition is supposed to be an accurate description of something real, then facts rather than argument are needed to settle the point. If, on the other hand, a writer wishes to define something in a particular way for purposes of discussion, there should be no reason to debate the matter. In such a case, however, it should be quite clear that the mere act of defining something in a particular way does not make it so in actuality. Psychologists and others have often given definitions of various "types" of mental processes and capacities. In this case, however, further investigation has often failed to reveal the existence of the "types" in real life. The primary purpose of definition is to make for mutual understanding; but definitions prove nothing and create nothing—except ideas.

The Explanation of Scientific Facts

Some General Principles.—Scientific method requires us at the outset to discard our preconceived ideas. Science makes few assumptions, but it must assume certain things. The fundamental assumption is that of the uniformity of nature, *i.e.*, that the forces of nature operate in the same way from day to day, that the same causes always lead to the same results. This cannot be proved; it must be assumed. Without it no laws and no prediction are possible. In the process of explanation (to be discussed presently) science further requires that we explain the unknown in terms of the known and not in terms of something about which we know even less than the thing to be explained. The attempt to explain peculiar conduct by supposing it to be due to witchcraft is a case in point. Also scientific

method requires that we use the simplest and most direct method of explaining things rather than resorting to more complicated explanations.

The Nature of Scientific Laws.—Cause and effect and *explanation* are terms often used in science, but their real meaning is often not understood. Let us examine a case. A ball is thrown into the air and falls back to the earth. We are in the habit of explaining this by saying that the cause of this effect is the action of gravity. Gravity is perhaps quite generally thought of as an agent or a mysterious power which forces bodies to act in a particular way. It should be realized, however, that, essentially, gravity is a very useful and very convenient figment of the imagination. The physicist observes the action of a large number of bodies in certain ways and he finds that he can *describe* certain things about the action of all of these bodies in very brief terms. He observes that bodies attract each other directly as the sum of their masses and inversely as the squares of the distances between them. He expresses this generalization of his observations in symbolic form and it comes to be known as the *law of gravitation.* It remains, however, nothing more than a concise description of certain phenomena classified into a group. When we explain the falling of a stone by saying that it is caused by gravity, we are simply classifying the falling of the stone in the general group of falling bodies. All explanation is of this sort and is essentially classification into a previously described group of phenomena. A law in science is simply a description which after repeated tests and applications has been found to describe accurately the phenomena in question; and it often happens that the term *law* is applied when it describes in only approximate terms the phenomena in question. In such cases further investigation often modifies and corrects the statement of the law, *i.e.*, makes the description more accurate.

Tendencies.—In dealing with complex phenomena such as are found in the study of individual differences, it is often impossible to isolate the action of a single factor. Rather we are forced to study results which follow from the action of a group of forces. In such a case we do not typically find the direct relation between cause and effect which we may be led to expect on the basis of the ordinary conception of the operation of natural laws. The action of one agent may be and often is modified or counteracted by the action of other agents. Under such conditions it is, therefore, better to use the word *tendency* rather than the word *law.* In case of a law an exception proves, *i.e.,* tests and *destroys,* the rule; while in case of a tendency an exception only indicates the counteractivity of other forces. The student of psychology should clearly understand that a given result may follow from any one of several causes and that a given cause may, because of the effects of other factors, lead to different results at different times. It is simpler and easier to think in terms of the mechanical action of a single factor, but this single-track habit of mind is certain to lead to error, and the student must strive to overcome it and learn to look for and analyze the variable factors which are so often encountered.

Fundamentally, of course, we may consider that nature operates just as mechanically in the field of mental life as in the field of celestial mechanics; the difference is that in the latter field it is more generally possible to measure and predict the effect of the various important variables, while in the former field there are more often too many unmeasured variables to make our predictions at all certain.

The use of the word *tendency* does not then imply that mental phenomena do not follow laws; it suggests simply that under existing conditions our analysis and

measurements are incomplete. However, when we are dealing with complex phenomena, we should think in terms of complex causes and not simply in terms of the operation of single laws.

The Real Problem of Science

In the last analysis the work of the scientist consists in the accurate determination and organization of facts. The extreme importance of this conception of science cannot be overemphasized in a subject which, like the psychology of individual differences, is the playground of theories, prejudices, and superstitions.

The Function of Theories in Science

It is not intended here to reach a conclusion in agreement with that of Bacon that all theories in science are bad. Theories are, in fact, absolutely essential in science. They are the basis of the intelligent collection of facts and often aid in their organization and, when sufficiently verified, become laws. Too often, however, the effect of the theory is bad; it is accepted as if it were a law, and receives a degree of prominence entirely unjustified in any case, and, if, as very often happens, the theory is incorrect, it becomes an impediment to future progress. Unfortunately, a considerable part of the work of the individual psychologist consists in the destruction of unsupported opinions as to the nature of individual differences. The student should endeavor to form the habit of a critical attitude and should distinguish as clearly as possible between facts observed under carefully controlled conditions by competent scientists trained in that particular field and the observations of the untrained. Also he should distinguish clearly between fact and theory, and between theory and well established law. Theories should be held with a degree of tentativeness to suit the evidence in their favor, and one must

be ready to quit them like a boat when it ceases to be seaworthy.

When Doctors Disagree

The relatively untrained student is often perplexed by the conflict of opinion among different writers or teachers. What view shall he accept? There is no infallible guide here, but it would seem wiser and safer, in general, to accept the views of those who have made the most extensive and intensive study of a subject and have had the widest experience in dealing with it. Biologists probably know more about evolution than the members of state legislatures know about it. Men who have devoted their lives to the scientific study of heredity probably know more about it than philosophers and sociologists and social psychologists know about it. Psychologists who have spent a good many years working with mental tests probably know more about the tests and what they measure than is known by the layman or by their brother psychologists who have not worked especially in that field. Generally it is wise to go to a physician when ill or to a lawyer when in legal difficulties. The beginning student will do well to keep this principle in mind in attempting to decide between conflicting views. And when, as frequently happens, the experts in a particular field do not agree, it is wisest not to accept any view on the subject too implicitly.

Science as a Growing Body of Knowledge

New discoveries are constantly throwing new light on old facts and so are forcing the modification of previous conceptions. The faster a subject is growing, the more rapidly these changes occur. Growth in scientific knowledge is not and cannot be simply by a process of addition. Modifications of the existing structure are just as essential as are additions. In a growing subject, especially,

dogmatic finality should be avoided. In a new subject, then, such as the psychology of individual differences, a willingness to accept new facts and to revise old views is a necessary foundation of growth.

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CHAPTER II

THE RELATION BETWEEN PHYSICAL AND MENTAL TRAITS

Psychology is concerned primarily with mental processes, capacities, tendencies, and reactions; but in actual practice we are constantly making judgments of individual psychological differences on the basis of physical differences, and for this reason it becomes necessary to consider the real relation existing between physical and mental phenomena. In the second place, as we shall see more fully later, mental functions are very definitely linked up with bodily functions and so we can add materially to our understanding of mental activity by studying the related physical states.[1]

THE NERVOUS SYSTEM

Relation to Mental Processes

The part of the body most closely related to mental processes is the nervous system. In a general way the relation of the brain to the mind has long been recognized, but most of our definite and detailed knowledge on the subject has been gained in the past fifty years. Aristotle (384-322 B.C.) thought the various senses were connected with the heart, and he described the brain as a cooling plant

[1] The present discussion of mind-body relations is not at all concerned with ultimate metaphysical questions. What is set forth here can be reconciled with spiritualism, with materialism, with dualism, or with any other logical system. It would only be necessary to make a few minor changes perhaps in wording. The present point of view is empirical and scientific rather than metaphysical.

for suppressing or cooling off too great emotional activity. Not until Gall and Spurzheim published their works on phrenology (1808-1825) was the importance of the brain adequately recognized as the basis of mental functions. As we shall see later, their results were valueless as far as detailed conclusions were concerned, but they did perform a service in the sense that they attracted attention to the brain as the seat of consciousness. For a time phrenological ideas had considerable vogue among scientific men, but in 1824 Flourens published a paper in which he reported the results of some experiments in which he had extirpated various parts of the cerebra or large brains of pigeons without securing significant differences for the different areas. The experimental work of Flourens was continued over a number of years with similar results and this tended to destroy the phrenological system and left in its place an equally erroneous idea that there was no difference in the functions of the parts of the cerebrum.

Since 1870 a large number of experiments have been made by different observers which have served to upset the well established idea that there was no localization of special functions in the cerebrum. At the present time, various lines of evidence afford convincing proof that to a considerable degree specialization of function exists.

Nerve Structure and Function

Before considering the parts of the brain and their functions, it will be useful to consider the structure and function of the nerve cell, or *neurone,* the unit of which the nervous system is composed.

The Neurone.—The nerve cell may be divided into the *cell body* and its branches. The cell body, an irregular affair of numerous forms, is much the largest part of the neurone but is of microscopical size, having a diameter

ranging ordinarily from $\frac{10}{25000}$ to $\frac{40}{25000}$ of an inch. Within the cell body is a round body, the *nucleus*. The nucleus is the center for the vital activities of the cell and probably converts the food elements received from the blood into a form suitable for use by the nerve cell. The nucleus is known to be essential to the life and growth

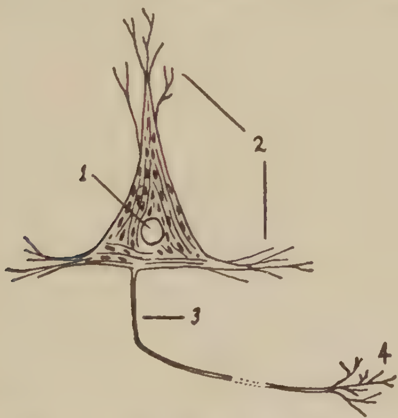

FIG. 1.—A NEURONE OF THE MOST COMMON FORM FOUND IN THE CEREBRAL CORTEX.

1, Nucleus; 2, dendrites; 3, axone; 4, end brush. Nissl bodies and fibrils are shown in the cytoplasm.

of the neurone, but it does not appear to have any specific nervous functions. The part of the cell body surrounding the nucleus is known as the *cytoplasm*. It appears to be the part of the cell body specifically concerned with nervous functions. Within the cytoplasm are found a number of structures. With appropriate staining methods there may be seen distributed through the cytoplasm small granules known as *Nissl bodies*. These are larger and more numerous in cells after a period of rest, and decrease or disappear with fatigue or with exhaustion from

other causes, such as high fever. They are accordingly supposed to represent the stored-up energy of the cell. They are relatively larger and more numerous in the large cells connected with common motor functions and smaller and less numerous in the association areas.

In the cells of the aged there may be seen to a greater or lesser extent a deposit of a yellowish substance more or less like the yellow fat in a chicken, and this, because of its lipoid character, is known as the *lipochrome pigment.* It occurs at a very early age in some cells of the brain stem and only very rarely in some other cells, as, for example, the Purkinje cells of the cerebellum. In the pyramidal cells of the cerebral cortex, pigment appears to a considerable extent with the onset of senescence. The exact significance of the lipochrome pigment is uncertain, but it is possibly a waste product of cell metabolism which is not eliminated. As such it would indicate a decay in the functional efficiency of the cell. In any case, if the pigment increases too much, it eventually invades the nucleus and the cell dies. Since nerve cells do not regenerate, the loss is permanent. There are also other pigments that appear to be associated with nervous degeneration, but they will be passed over here.

The cytoplasm contains another well-known set of structures, the *neurofibrils.* These are small fibrils running in all directions. They are sometimes supposed to be the conductors of nervous impulses, but this is at present without adequate experimental proof.

Nerve Processes.—The processes of the nerve cell are of two kinds. Within the central nervous system the nerve cells ordinarily have a number of short processes which are simply extensions of the cell body. These are known as *dendrites.* Their special function is the reception of nervous impulses. In addition to one or more dendrites each neurone has one other process, the *axone.*

The axone is a small threadlike affair with various branches. It varies from microscopic shortness to several feet in length. It conducts impulses from the cell body.

Some of the neurones outside of the central nervous system have two processes each with the structure of an axone, and in that case one axone is the receiving part of the cell and the other axone is the transmitting part. For convenience it is better perhaps to call the receiving process a dendrite, even though in this particular case it is structurally an axone.

Axone Sheaths.—All true nerve substance in the brain is gray in color. When axones mature and are ready to function, they have usually acquired a sheath of a white fatty substance known as *myelin,* so the sheath is called the *myelin sheath.* Sometimes it is also known by the not very appropriate name of *medullary sheath.* The evidence indicates that, in brain workers at least, the myelin sheath increases in thickness in certain parts of the nervous system until the age of forty or fifty years. This is the only known change in the brain that can in any way be associated with the exercise of mental functions. The significance of the myelin sheath is, however, uncertain. It is frequently supposed that it acts as an insulator, but there is little to support this view except analogy. On the electric wire the insulation prevents loss of current or short-circuiting. Nothing like this has been satisfactorily demonstrated for the myelin sheath. It is known, however, that unmyelinated fibers of the sympathetic nervous system conduct nerve impulses more slowly than do the myelinated fibers of the central nervous system. If the function of the myelin is in any way significantly related to this difference in rate of conduction, it is entirely different from the function of the insulation on an electric wire. No satisfactory statement can be made at present as to the real function of the myelin, but it appears to the writer

that the sheath results in some way from the functional maturity and activity of the neurone and is to be regarded simply as an indicator of functional efficiency in some neurones. Some nerve fibers never have such a sheath, although they are functionally efficient. Why this difference exists we do not know. It may be pointed out, however, that the long peripheral fibers connected with the central nervous system have the thickest myelin sheaths, while the fibers of the sympathetic nervous system have thin ones or none at all. If the myelin is associated with speed of conduction, it is easy to see that speed is very important in the activity of the voluntary motor mechanism, while it is of no special importance in the regulation of the digestive processes. In dodging an automobile a small fraction of a second may mean the difference between life and death, but in regulating the digestion of a meal a fraction of a second or even several seconds' difference in time would not be important. In the thinking processes speed is an important factor and the myelin sheath appears to thicken with exercise of the association areas.

Outside of the central nervous system axones are surrounded by a sheath known as the *primitive sheath, neurilemma,* or *sheath of Schwann.* When such axones are cut, the primitive sheath makes it possible for them to regenerate.

The Spinal Reflex

The practical working of the nervous system may be conveniently illustrated by the mechanism of the spinal reflex. If a stimulus, say the prick of a pin, is applied to the skin of the hand, it stimulates the nerve ending and a nerve impulse passes over the course indicated by the arrow in Figure 2. The cell bodies of the sensory neurones are located in the spinal ganglion. From the axone of the first

or *sensory neurone* the impulse passes over a *synapse* or point of contact to a dendrite of a second neurone, known as a *central* or *association neurone*. From this the impulse passes across a second synapse to a third *motor* or *efferent neurone*, and this conducts the impulse to the muscle of the arm which causes the withdrawal of the arm from the stimulus.

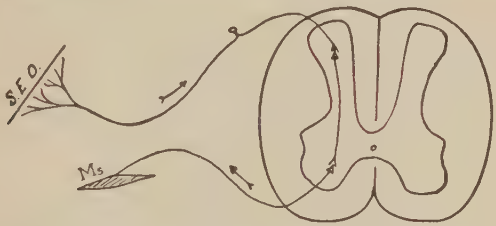

FIG. 2.—THE MECHANISM OF THE SPINAL REFLEX.

A stimulus applied to a sensory end organ (*S.E.O.*) in the skin would cause a nervous impulse to travel over the sensory neurone to the dorsal part of the spinal cord where it would enter the gray matter of the cord (the *H*-shaped part) and connect with a second neurone. The place where the impulse passes from one neurone to another is known as the synapse. The second neurone is known as a central or associational neurone. From this the impulse passes across a synapse to a third or motor neurone and out the ventral side of the cord along the motor axone to a muscle (*Ms*). The impulse causes the muscle to contract and this completes the reflex.

This simple drawing misrepresents, however, in one especially important respect the actual functioning of the central nervous system. The central nervous system consists of neurones of the second or association type. The purpose of these neurones is to make connections between different sensory paths and different motor paths. In the illustration only one sensory and only one motor pathway are shown. If this were the real condition, there would be no excuse for the existence of the central neurone. Figure 3 shows in schematic form the way in which the central neurones really function.

A sensory stimulus applied to the sensory neurones, S_1, S_2, S_3, etc., may be transmitted over a central neurone C_1 to either of the motor neurones M_1, M_2, etc. This may in turn be reinforced or inhibited by an impulse arising from another central neurone, as C_3, or from one of the sensory neurones S_4, S_5, and transmitted over the central neurone

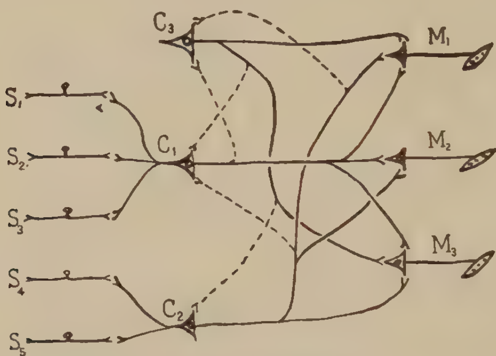

FIG. 3.—A SCHEMATIC DIAGRAM TO ILLUSTRATE THE WORKING OF THE NERVOUS SYSTEM.

The central neurones link up the sensory and motor neurones so that a stimulus applied to any sensory neurone may be transmitted to any motor neurone. Not only do the central neurones connect sensory and motor neurones, but they also connect with other central neurones. Axones drawn with a dotted line represent such possible connections. Also there may be many central neurones in the circuit between the sensory and motor neurones.

C_2, to the same motor neurone influenced by the impulse from C_1. The central neurones are so interlinked and connected that each impulse has a number of paths from which it may choose the one it follows. It should be recognized that the word "choose" is inappropriate here, because in reality the impulse follows the path of least resistance as determined by natively formed pathways, habits, and inhibitions. Reflexes and instincts are thus to be thought of as preformed pathways in the nervous system, or, in more

exact language, a reflex would result from the fact that the synaptic resistance to the passage of an impulse between particular sensory, central, and motor neurones

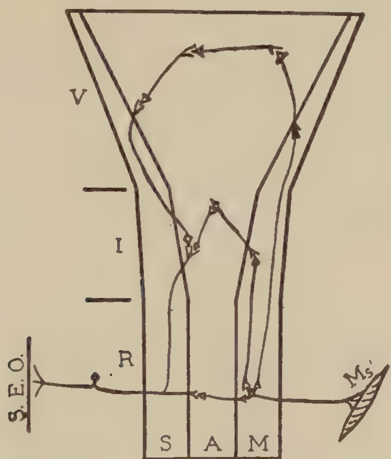

FIG. 4.—SCHEMATIC DIAGRAM ILLUSTRATING THE THREE LEVELS OF ACTIVITY OF THE NERVOUS SYSTEM.

On the lowest or reflex (*R*) level the impulse passes directly over to the motor neurone. On the second or instinctive (*I*) level the impulse goes to a higher center, the thalamus, and involves more central neurones before finally reaching the motor neurone and stimulating the muscles and glands. On the third or higher conscious and voluntary (*V*) level the impulse goes to the cerebrum or large brain and involves a large number of associative connections before being finally transmitted to the motor neurone. The diagram shows how the three parts of the nervous system, the sensory (*S*), the associational (*A*), and the motor (*M*) vary at the different levels. On the higher levels the association fibers increase greatly in number and importance and the sensory and motor fibers decrease relatively in importance.

would be natively lower than the resistances of the synapses of other pathways. Similarly the formation of an association or of a habit would consist in the lowering of the synaptic resistance between certain neurones so

that an impulse would readily travel over the pathway so formed. When different central neurones connect with the same motor neurone, they furnish the mechanism which makes possible the reinforcement or inhibition of impulses.

In the actual working of the nervous system many central neurones are ordinarily involved in the correlation processes associated with conscious activity.

General View of the Nervous System

A general idea of the working of the nervous system may be gained from the schematic diagram in Figure 4. In the

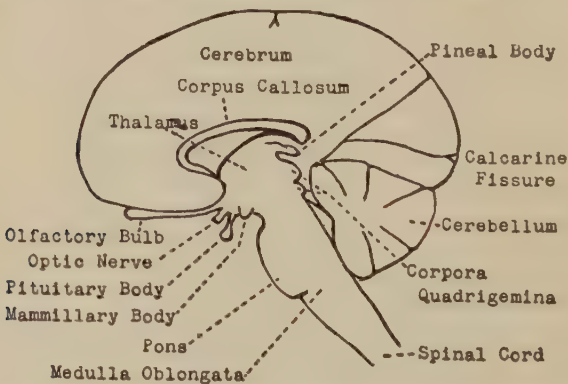

FIG. 5.—THE MESIAL SECTION OF THE RIGHT HALF OF THE BRAIN.

figure, three levels of activity are represented: reflex, instinctive, and consciously controlled or voluntary. There is, in fact, no exact limit between these three kinds and each shades into the one or ones next to it, but the distinction is a useful one for practical purposes. Each of these levels of the nervous system is further divided into three regions: sensory, associational, and motor. The higher the level the more important relatively is the association area. Most of the cerebrum consists of association centers.

No adequate grasp of the actual specific centers and pathways of the nervous system can be gained without an enormous amount of detailed work, but it will be useful for the student to become acquainted with the chief divisions of the brain and their functions. For this purpose Figures 5 and 6 are given.

Figure 5 shows the mesial or middle section of the brain with the names of the parts. Figure 6 shows the lateral

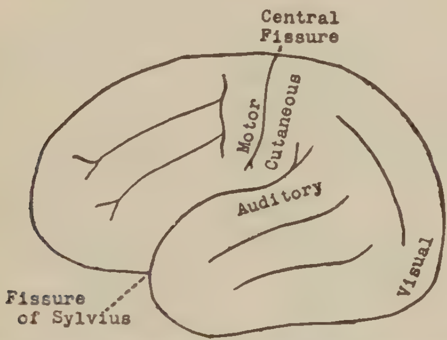

FIG. 6.—THE LATERAL SURFACE OF THE LEFT HEMISPHERE OF THE CEREBRUM.

surface of the left hemisphere of the cerebrum. Both of these sections should be studied until they can be reproduced with the book closed. The names and functions of each part should also be learned. To this should be added a study of Figure 7 showing how the association fibers connect the different areas of the brain. Unless this is done, great confusion will result from an attempt to think of the neural basis of various conscious processes and reactions. A clear grasp of these facts will enable the student to free himself from the many popular misconceptions of the nature of individual differences in mentality and of the way these differences are influenced by experience, including education. He will no longer think that the study

of algebra or Greek will deepen the brain fissures or increase the number of nerve cells or convolutions or improve the quality of the brain tissue in general.

FUNCTIONS OF THE PARTS OF THE BRAIN

Spinal Cord.—The spinal cord is the center for reflexes of the trunk and limbs resulting from stimulation of cu-

FIG. 7.—THE ASSOCIATION FIBERS OF THE CEREBRUM.

A, between adjacent convolutions; *B,* between frontal and occipital areas; *C,* between frontal and temporal areas, *cingulum; D,* between frontal and temporal areas, *fasciculus uncinatus; E,* between occipital and temporal areas, *fasciculus longitudinalis inferior; CN,* caudate nucleus; *OT,* optic thalamus. (After Starr, *Atlas of Nerve Cells.*)

taneous and kinæsthetic sensory end organs. It is also a conduction pathway for fibers going to and from the higher centers.

Medulla Oblongata.—The medulla is a conduction pathway and reflex center controlling such vital reactions as breathing and heart beat.

Midbrain.—The midbrain is a conduction pathway and an important reflex center. On the dorsal part of the midbrain are four small elevations known as the *corpora quadrigemina* (four-fold bodies). The upper pair of these, the superior colliculi, constitutes the reflex center for sight. The lower pair constitutes the reflex center for hearing.

Mammillary Bodies.—The mammillary bodies are the reflex center for smell.

Thalamus.—Center for instinctive activity and emotions, probably also for sensation of pain.

Cerebellum.—Center for reinforcement and coördination of motor impulses. Regulates equilibrium.

Pineal Body.—Gland of internal secretion. No function in adults, but probably acts as an inhibitory organ to prevent premature development of nervous system, skeleton, and sex organs during the period of growth.

Pituitary Body.—Gland of internal secretion. Anterior part stimulates growth of the skeleton and may have stimulating effect on nervous system. Posterior part stimulates sympathetic muscle.

Corpus Callosum.—Consists of fibers connecting corresponding areas of the two hemispheres of the cerebrum.

Cerebrum.—Center for all conscious activity. Seat of learning and voluntary activity. The cerebrum contains a sensory center for each of the senses. In Figure 6 the cutaneous, auditory, and visual sensory centers are shown. The visual area is, however, mostly on the mesial surface of the cerebrum on each side of the calcarine fissure (see Fig. 5). The olfactory area is in the hippocampus, which cannot be seen on either surface of the brain. The gustatory or taste area is not so definitely located but is probably close to that for smell. Destruction of the sensory area for any sense causes a loss of the sense itself. Destruction of the auditory area in both hemispheres of the cerebrum, for example, would make a person totally deaf.

The voluntary motor area is just in front of the central fissure. Injury to this area will cause loss of motor control. There is a definite localization pattern within the motor area: the centers for movements of the feet are at the upper end of the central fissure and those for movements of the head are at the lower end of the fissure with the other centers arranged in order in between. Application of an electrical stimulus to a particular point will cause a movement of the corresponding set of muscles.

The cortex outside of the sensory and motor areas consists of association centers. In general these are especially related to the adjacent sensory and motor centers. The frontal association center, for example, is especially for motor learning. The association area below the auditory sensory area is especially for auditory learning, etc.

In the lower part of the frontal lobe of the left hemisphere is the motor speech association center known as *Broca's area.* Loss of this area will result in loss of the ability to talk. However, if no other area is affected, the individual will still be able to read or to understand spoken language; for there are also special association centers for reading and understanding spoken language.

A consideration of the facts just presented shows that there are many specific centers in the brain with specific functions. In the actual working of mental processes, however, specific neurones in several parts of the brain would be involved at the same time. This is sometimes stated by saying that the brain works as a unit; but this is very misleading, because the conclusion may be readily drawn that all of the billions of neurones are acting at once, which is contrary to the known facts.

Significance of Brain Size

In comparing different species of animals there is a rough correlation between size of the cerebrum in relation

to body weight and intelligence. In comparing individuals of the same species, however, the relation between brain size and intelligence is so slight that it has no practical use save in a very few exceptional cases. An extremely small brain always indicates mental deficiency and an extremely large brain is more than likely to be associated with deficiency, though not necessarily. Within rather wide limits we find little relation between brain size and intelligence, however, because mental defectives have brains of all sizes from the smallest to the largest, and, similarly, brilliant men have brains ranging from very large to considerably smaller than the average.

Phrenology

Gall thought that the brain was divided into sharply circumscribed areas each of which was responsible for some complex function, such as courage, language, harmony, etc. In spite of the fact that his system has been discredited by scientific studies of the structure and function of the brain, belief in the system still persists and the average individual is likely to be unduly impressed by a broad expanse of bone—if it happens to be the forehead. Worse than this, people in general, and especially teachers, are constantly passing judgment on the intelligence of individuals by looking at their faces; and various facial characters are associated with various supposed mental and physical traits. The child with a clear skin, regular features, bright eyes, and lively expression is pretty likely to be rated higher than his classmate of less prepossessing appearance. The fact that such judgments are sometimes correct is likely to overshadow the fact that they are often wrong and rarely very accurate. The most exact scientific methods in use today do not make possible an accurate estimate of intelligence by any kind of combination of measures of the face or head. The reason for this is not far to seek. In the

first place, the characteristics so nicely located by Gall in limited brain centers are known to be complex and to involve neurone connections between several parts of the brain. In the second place, if the areas were so circumscribed, there is little reason to believe that it would make a visible difference in the skull. The brain never fills the cranial cavity and it is surrounded by the cerebrospinal fluid which occupies from 7 to 30 per cent of the cavity. The size of the brain cannot, therefore, be determined by examination of the head. Gall assumed that great growth of a particular part of the brain would push out the overlying part of the skull. This is contrary to the physical law for the pressures of fluids. According to this law, if a part of the brain grew more than another part, the cerebrospinal fluid would distribute the pressure evenly over the entire surface of the skull. The skull as a whole would enlarge. An exaggerated example of skull expansion is seen in cases of hydrocephalus (water on the brain) where more cerebrospinal fluid is secreted than is eliminated, with the result that an enlargement of the skull occurs. According to Gall, this should indicate a great and harmonious development of all mental faculties, so-called. In fact, such individuals are usually, though not always, defective.

A further flaw in Gall's argument is found in the fact that the skull is not of uniform thickness, nor are the variations in the thickness of different areas the same in different individuals. In a particular area the skull may be from ¼ to ¾ of an inch thick in different people, and only by an X-ray could the thickness be determined in a particular case. It is thus impossible by phrenological methods to detect anything of importance.

Only in very exceptional cases will a direct examination of the surface of the cerebrum enable one to draw any conclusion as to the intelligence of the individual who pos-

sessed the brain. In one case within the writer's experience, a microcephalic idiot who died at the age of about 20 years had a cerebrum weighing about 600 grams (normal about 1,200). The fissures of the cerebrum were few in number and the convolutions were, therefore, broad, the whole appearance being much less complex than the normal. Such cases are extremely rare, however, and in most cases even microscopic examination of the nerve cells and fibers would, in the present state of our knowledge and technique, not reveal small differences in the development of particular areas and capacities.

The attempt to determine intelligence by study of facial characteristics, such as eyes, nose, mouth, etc., is even farther removed from any basis of established scientific fact. The determination of emotional disposition by observing the face is a somewhat different matter, because if a person habitually frowns, the muscles and skin may acquire a habitual set indicative of the attitude, and even the resting face may show the individual's characteristic disposition. But no conclusion as to character or intelligence can at present be based on the size or form or regularity of the eyes, ears, nose, or other such relatively fixed features. Lombroso popularized the idea that criminals, mental defectives, and other inferior "types" could be detected by observing various *stigmata of degeneration,* as he called certain irregularities in the features. Unfortunately for his theory, it is found that his so-called stigmata appear in normal people, and defectives are often met who show surprising symmetry and beauty. Defectives as a group do show more stigmata than normals as a group, but there is too much overlapping between groups for the stigmata to be of practical value in differentiating the two. In spite of the popular faith in such methods of determining character and intelligence, they do not rest on an adequate basis of scientific fact.

Brains of Mental Defectives

What difference, if any, will the microscope reveal between the brains of mental defectives and normals?

Hammarberg (1895) reported the results of a microscopical study of a number of cases of mental deficiency.[2] He found considerable irregularity in the development of different brain areas. In particular areas or in the whole brain there would be a scarcity of nerve cells; the cells would sometimes be smaller in size; and their orientation would be disturbed. Some would be upside down, some would be on their sides, and other derangements would be found.

Bolton studied a number of cases of deficiency and found a markedly inferior development in the frontal lobes. He concluded that this area was especially affected in mental deficiency.[3]

The writer studied the Purkinje cells of the cerebellum, which are especially concerned with coördination and reinforcement of motor impulses, and found that in the cases examined there was a marked deficiency in number of cells.[4] This definitely discredits Bolton's idea that changes in the frontal lobe are primarily responsible for even the motor aspects of mental deficiency. The writer also studied several areas of the cerebral cortex and compared the numbers of cells, sizes of cells, and other features with the results of studying the same areas of normal brains. The

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[2] C. Hammarberg, *Studien über Klinik und Pathologie der Idiotie,* trans. from Swedish into German by W. Berger (Upsala, S. E. Hensen, 1895).

[3] J. S. Bolton, "The Histological Basis of Amentia and Dementia," *Archives of Neurology,* Vol. 2 (1903); *ibid.,* "A Contribution to the Localization of Cerebral Function Based on the Clinico-Pathological Study of Mental Disease," *Brain,* Vol. 33 (1908), pp. 26-148.

[4] R. S. Ellis, "A Preliminary Quantitative Study of Purkinje Cells in Normal, Subnormal and Senescent Human Cerebella, with Some Notes on Functional Localization." *Journal of Comparative Neurology,* Vol. 30 (1919), pp. 229-252.

results showed that mental inferiority was associated with a number of differences in cortical development. In agreement with Hammarberg a deficiency in cell number and various abnormalities in cell arrangement were found. Numerous cells in an undeveloped condition were found in the white matter where they had stranded and failed to complete their migration to the cortex. In such cases the cells were entirely undeveloped and presented only the nucleus surrounded by a thin mass of cytoplasm. Accurate measurements show that the ratio of cytoplasm to nucleus increases with the development of the cells. The cytoplasm is less developed in the neurones of mental defectives. With the deficiency in cytoplasm goes a deficiency in number of dendrites and consequently in the possibility of associative connections.

The mental defective is, then, often handicapped by a general deficiency in nerve cells and by a lack of growth and organization of the cells he has, and so is hopelessly out of the race from the start. The number of nerve cells is complete soon after birth and they attain their maximum size by the age of two or three years, so it is evident that before the child enters school the limits of his mental development are already determined.

The Nervous System in Insanity

There are many varieties and gradations of insanity. It is not intended here to attempt a statement even of the differences in the nervous system which are well known to exist in certain types of cases. It is important, however, to point out that some forms of insanity do show characteristic brain lesions. Also it should be noted that tumors, abscesses, and softened areas in the brain, when located in particular areas, show some uniformity of symptoms. It is true that in some forms of insanity it is not possible to point out any constant lesion, but the fact that they are

found in other cases shows that specific mental disturbances are associated with specific brain areas. Also it is known that insanity tends to run in families, and in a large number of cases there appears to be a definite hereditary basis for it. Both of these facts would lead us to expect a close connection between physical and mental inheritance.

In concluding the discussion of the nervous system, it is evident that, while common beliefs of a phrenological nature are not supported by science, there is a great deal of evidence to show that individual differences in mental capacities are associated with differences in nerve structure and function.

GLANDS OF INTERNAL SECRETION

Next to the nervous system in importance among the physical factors influencing mental growth and activity come the *glands of internal secretion.* There are two kinds of glands, the glands with ducts or outlets, such as the salivary glands, which pour their secretion into some part of the body, and the ductless glands which have no duct or outlet but have their secretion taken up by the blood circulating through the gland. The general names applied to these secretions are *hormones* and *autacoids.* Hormone is the more commonly used term.

Hormones

Our knowledge of the effects of the hormones is more recent and more deficient than that of the structure and function of the nervous system. Up to 1849 nothing was known of the function of the glands of internal secretion. In that year Berthold demonstrated by experiment that the sex glands, in addition to the production of sex cells, also supplied the blood with something which regulated the secondary sex characteristics. The effect of these glands on mental processes has only recently been appreciated.

Cannon's work on bodily changes in the emotions, published in 1915, was a pioneer piece of work in demonstrating the effect of internal secretions on the emotions. Today we have more problems than facts about the internal secretions, but at the same time enough has been learned to show that the glands have an enormous influence on both mental growth and mental activity.

By way of introduction to the subject it may be stated that these glands fall into two groups: those that are excitatory in their action and those that are inhibitory. Also each hormone affects only certain specific tissues, although the blood containing it circulates through the whole body. Neither normal growth nor normal functioning of many of the organs of the body, including the brain, is possible without the appropriate internal secretions.

The Thyroid

The thyroid gland is located in the neck. In some cases it enlarges and becomes conspicuous as a goitre.

Experimental work on the thyroid is difficult, because it covers and more or less surrounds the parathyroids, which are essential for life. If, consequently, the whole of the thyroid be removed, the parathyroids will ordinarily also be removed or injured and death will follow as a result of parathyroid injury before the effects of the loss of the thyroid can be observed. In early experiments much confusion resulted from the failure to distinguish between the effects of the removal of the thyroid and the removal of the parathyroid.

It occasionally happens that a child has no thyroid tissue, and in such cases we get the best examples of the effect of loss of the gland. These children develop normally until the close of the nursing period and then suddenly stop growing. The rate of metabolism is decreased, the temperature is low, and general bodily functions decrease in

rate. Mental growth stops and the child remains an idiot or imbecile. If the child lives to the age of adolescence and maturity, it fails to develop the adult sex characteristics. Some of these children become obese, but otherwise there is little change in size.

In adults, when the thyroid is lost as a result of disease or of operations, a regressive process takes place with an end result similar to that in the infant. There is, of course, no loss of stature; but the mind rapidly deteriorates and sexual functions are lost. The hair drops out, the skin becomes dry and wrinkled, and general metabolism is lowered. If under these conditions thyroid tissue is grafted under the skin at any convenient place, a cessation of these symptoms follows and the patient rapidly regains the normal mental and sexual condition. In actual practice in such cases the dried gland of the sheep is usually given by way of mouth. The results are the same as for grafting.

These results indicate that the thyroid in some very important way stimulates the general growth of the body especially of the nervous system and sex organs.

In Switzerland and in the central section of the United States, especially in mountainous regions and near the Great Lakes, the thyroid is often found to be enlarged but with indications of deficiency in function. It is stated that about 80 per cent of the dogs around Cleveland suffer from enlarged thyroids, and a large per cent of those around Chicago suffer the same way. Such conditions where a large part of the population are affected occur much less frequently near the seacoast. This has led to studies of the water of the affected regions, and it appears that in regions where the rainfall comes from the ocean, thyroid deficiency is much more rarely met than in regions where the rainfall is from the evaporation of snow or from the evaporation of fresh water, as in the north central part of the United States, especially around the Great Lakes.

The presence of iodine in the thyroid has been long known, and iodine has been used with success in treating thyroid deficiency. Near the ocean, burnt seaweed, which contains iodine and from which commercial iodine is extracted, has been used with success as a poultice. From this it seems that the thyroid enlargement or deficiency in the interior of countries such as the Swiss Alps is due to the fact that, while normally rain water, in addition to pure water resulting from evaporation, contains various substances in solution, including iodine, which have been taken up by the ocean winds from the spray and have been blown inland until they fall as rain, in the interior parts of the country with high mountains between them and the ocean, all or most of the water from the ocean falls on the ocean side of the mountains and the rainfall within the inclosed area consists of water from the evaporation of snow or fresh water and so contains vastly less iodine and other solids. If, then, the thyroid is normally concerned with the regulation of iodine metabolism, as seems practically certain, in those regions where iodine is deficient in the water, hypertrophy of the gland would take place in an effort to compensate for the deficiency in the iodine available in the water and food. In certain regions in Switzerland, even with great enlargement of the gland, it would be impossible to supply enough iodine to the body tissues and the characteristic picture of thyroid deficiency would result. In the Great Lakes region of the United States the withdrawal from the ocean is not so complete and hypertrophy of the gland would be more nearly sufficient to compensate for the deficiency in the iodine content of food and water.

At the Mayo Clinic excellent results with such cases have been secured by feeding them the solids remaining after the evaporation of sea water. These include iodine and various salts, and it may be that more than iodine is neces-

sary to secure absolutely normal functioning of the gland; but at any rate iodine is the most important substance involved in its activity.

In contrast to endemic goitre, in which there is overdevelopment of the thyroid with underfunction, is goitre with overfunction. This is known as Graves' or as Basedow's disease. In myxœdema we found that absence of the thyroid in children resulted in cessation of growth and lowering of metabolism, and in adults it caused a loss of mental and sexual functions and lowering of general physiological activity. Overfunction of the thyroid, as we should expect, is accompanied by greater nervous irritability, by a moist skin, rapid pulse which increases quickly with slight exercise or excitement, and a wasting away of the body. The thyroid is usually enlarged in such cases and the eyes may protrude; hence the term "exophthalmic goitre." Exactly how the thyroid is related to the protrusion of the eyes is not known. The disease is much more frequent in women, which is in agreement with the fact that the function of the gland seems more important in women than in men.

In spite of the doubtful points as to the exact method of functioning of the thyroid, there can be no doubt that it is essential both for normal growth of the nervous system and for normal mental activity after growth is complete. This affords us another strong link in the chain connecting mental capacities and activity with bodily processes. And since the thyroid shows such wide and frequent variations in functional efficiency, it is an important factor in explaining individual differences in activity and temperament.

The Parathyroids

The parathyroids are variable in number, but in man there are usually four chief parathyroid bodies and at times other smaller ones located under the thyroid. Ex-

tirpation of the parathyroid causes a rapid increase in the irritability of the nervous system of the animal. The muscles soon show signs of tetany, and death results in a day or two after the operation. Administration of parathyroid will alleviate the animal's condition, as will transfusing blood from a normal animal. Administration of calcium also decreases the tendency to tetany and postpones death. Such evidence points to the conclusion that the parathyroids regulate the calcium metabolism of the body. In the absence of the parathyroid the blood is, in fact, found to be deficient in calcium. In man a deficiency in parathyroid is associated with the trembling palsy known as paralysis agitans. Such cases are improved by the administration of the parathyroid extract and calcium. The nerves and muscles are quieted and the symptoms tend to decrease. The effect of the parathyroid on the nervous system thus appears to be to prevent the overactivity of the neurones and perhaps to aid in their recovery from fatigue. Parathyroid deficiency seems to result in the exhaustion of the neuro-muscular system but the evidence is not yet conclusive.

Normally there is more parathyroid tissue than is required, so that there is probably no such thing as excessive secretion of the parathyroids. At least such is not known at present.

The Adrenals

The adrenal glands, also known as the suprarenals, are attached as thin capsules to the upper or anterior end of the kidneys. Removal of the adrenals causes muscular weakness and death. Administration of the adrenal extract is found to increase the excitement of the animal. From the point of view of the experimentalist, it unfortunately happens that the adrenals consist of two functionally different parts, the *cortex* and the *medulla*. This

has complicated the matter and made the securing of accurate results much more difficult.

The evidence at present indicates that the removal of the adrenal cortex is responsible for the death of the animal following the extirpation of the whole gland. The cortex also seems to stimulate sexual development and possibly the growth of hair on the body. The adrenal medulla is somewhat better understood. When an extract of it is injected, there is an increase in the heart beat and an increase in blood pressure. This last is partly due to a constriction of surface blood vessels which forces more blood into the deeper tissues. In violent anger turning "white" is due to this action. The effect of adrenalin on the muscles is to decrease fatigue, and by causing the release of the glycogen stored in the liver further food for violent muscular activity is produced.

In 1915, Cannon published his work on the *Bodily Changes in Pain, Hunger, Fear, and Rage.* This was pioneer work in this field. James and Lange in their formulation of the theory of the emotions known by their names had stated that an emotion consists of the consciousness of the reflex bodily changes produced by some exciting stimulus. Or to state the matter in greater detail, the perception of an exciting fact, such as seeing a bear when alone and unarmed in the woods, would produce a series of reflex bodily changes, such as rapid pulse, rapid respiration, hair standing on end perhaps, shaking of the knees, etc., and the consciousness of these changes would constitute the emotion. The chief difficulty in the way of accepting the James-Lange theory lay in the fact that we knew so little of the actual *internal* bodily changes taking place in the emotions. Much still remains to be done, but Cannon's work demonstrated the fact that an exciting stimulus caused a reflex secretion of adrenalin and this in turn caused a series of internal bodily changes. These changes fitted

the animal for rapid and energetic action, increasing his strength and decreasing his fatigue.

If the blood from an excited animal is injected into a resting animal the resting animal immediately shows signs of excitement. That the excitement is due to the material injected and not to the fact of being injected is demonstrated by using other injections, such as a normal salt solution, which will show no such effects.

Other more recent work has supported Cannon's conclusion and demonstrated a close relation between bodily changes and the emotions as supposed by the James-Lange theory. We still know too little about these changes to explain in detail the difference between such common emotions as fear and anger, but the general point of the dependence of the emotions on bodily changes may be considered established.

Sex Glands

We have mentioned the experiment of Berthold in 1849 in which he transplanted the testes of cocks from the normal position to another location under the skin and found that the cocks did not lose the male characters as they did after a complete removal of the organs. This result is due to the fact that the sex glands not only produce sex cells but also produce an internal secretion which regulates the development of the secondary sex characters. Sex development is itself conditioned by the development and secretions of the thyroid, adrenals, pineal, thymus, and pituitary, but the sex glands have a specific effect on the secondary sex characters. This is demonstrated by the results of the removal of the testes in young males with the result that the beard and voice and other secondary characteristics do not develop in the fashion normal for adults. Also the loss of the ovaries in the female may cause a regression with loss of sex characteristics. Sex emotions are quite

definitely dependent on the secretions of the sex glands. The great development of the interest in the opposite sex which comes with adolescence is due mostly to the effects of these secretions, and the great individual differences in such interest are to be associated with differences in internal secretions.

The Freudians have placed too much emphasis probably on the rôle of the sex instinct in determining mental life, but they have undoubtedly succeeded in demonstrating that an enormous amount of mental activity focuses on sex and is stimulated by sex. All of this is, of course, additional evidence of the importance of the internal secretion from the sex gland.

For the sake of accuracy it should be noted that the secretion is from what is known as the interstitial tissue of the sex glands, and for this reason the secretion is sometimes said to come from the interstitial gland.

The Pineal Body

The pineal body, otherwise known as the epiphysis, is attached to the dorsal part of the thalamus. Historically it is interesting to note that Descartes thought it might be the seat of the soul. This conclusion seems to have depended on the fact that the pineal had no known function, and on account of its central location it seemed a suitable place to locate the soul. Comparative anatomy relates the pineal body to a kind of third eye in lower forms. In man it apparently has no function in adults, but in children it is supposed to supply an internal secretion which inhibits the premature development of the sex organs and nervous system. Cases are reported in which children of five or six years developed the secondary sex characters of adults and also the interests of adults. They would discuss politics and theology with great interest and would not have the interests characteristic of normal children of their age.

After a few months such cases die, and autopsy shows a destruction by tumor or otherwise of the pineal gland. The evidence for this function of the pineal can hardly be regarded as conclusive. A study of more cases will be necessary to establish or disprove the conclusion.

The Thymus

The thymus is located over the heart. In infants it is relatively large. It increases in absolute size but decreases in relative size until the end of the period of puberty, when it normally declines in importance. This and other anatomical facts suggest that the thymus is in some way more essential during the period of growth, and it not improbably has a function similar to that of the pineal, *i.e.*, as an inhibitor of precocious sexual and mental development. Persistence of the thymus is associated with failure of the sex organs to develop normally, but it is impossible to say with certainty which is cause and which is result.

The Pituitary Body

The pituitary body, also known as the hypophysis, is located at the base of the brain. It has two lobes, the anterior and the posterior, and these have different functions. The anterior lobe supplies a hormone which regulates the growth of the bones and according to some recent experiments seems to have some effect also on the growth of the nervous system. Hypersecretion of this lobe during the period of growth results in gigantism. Apparently in some cases the energy of growth is used up in producing the skeleton, because the other organs fail to develop normally and physical and mental inferiority results. If the overactivity of the glands comes after growth is practically complete, an enlargement of the joints results. This is in extreme cases associated with an increase in the thickness of the lips and other facial changes which give the fea-

tures a heavy, stolid expression. In less extreme cases these changes are not conspicuous. Undersecretion of the gland in children produces an arrest of skeletal and sexual development with more or less mental impairment. Complete destruction of the gland results in great muscular weakness followed by death in a short time. The reason for this is not known.

The hormone from the posterior pituitary has an excitatory effect on smooth muscle. Like the adrenal medulla, the posterior pituitary affects the carbohydrate metabolism. One guess is that the posterior pituitary hormone has some influence on emotional activities of a sympathetic nature, but positive evidence of its psychological significance is lacking.

Numbers of other glands in the body appear to supply hormones; but the effects of these, so far as they have been determined, do not seem to be closely related to mental activity.

Relation of Internal Secretions to Human Nature

As would be expected, the discoveries of the effects of internal secretions have led to various hypotheses as to the relation of differences in these secretions to differences in human nature. Different "types" of personality have been supposed to be due to the dominance of the endocrine system by a particular gland. Thus adrenal dominance has been supposed to result in the active, aggressive fighter; anterior pituitary dominance to supply the distinct masculine type; posterior pituitary dominance to give the distinct feminine type; thyroid dominance to give the quick, ever active type; etc.[5]

In dealing with the subject of internal secretions in rela-

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[5] For an interesting but very speculative treatment of this problem, see L. Berman, *The Glands Regulating Personality* (New York, Macmillan, 1921).

tion to human nature, the student should bear in mind that those who explore new fields of knowledge always make many incorrect inferences. The history of science often misleads by giving us an account of only the successful hypotheses and experiments of great scientists. It is necessary to recognize that there have been more wrong guesses than right ones and even apparently obvious inferences based on known facts will not infrequently be misleading or even false. The greatest caution and conservatism are, therefore, essential in dealing with new problems if we are to avoid the acceptance of false conclusions.

The student should learn to expect frequent revisions of principles and reinterpretations of facts in new and rapidly growing sciences. Even in physics, the oldest of the natural sciences, we have recently revised certain principles by the introduction of the principle of relativity. The chief danger of hypotheses and new theories and their applications lies in the fact that they are often taken too seriously. The true scientist makes a marked distinction between those principles that have been thoroughly tested and found valid and those that have not successfully passed through such a period of probation. These last he holds lightly and tentatively and is ready to modify them with the appearance of new evidence. Here lies chiefly the difference between superstition and dogmatism on the one hand and science on the other. Unsupported superstitions and dogmas of various kinds are clung to tenaciously without an attempt to test them out experimentally to see if they really work. Their acceptance is not based on rational experience and even contrary evidence does not modify them. Psychologically the great liking men have for fixed principles is largely due to mental inertia. It is so much easier to apply a formula mechanically than it is to analyze a situation and modify a conclusion. A great minister once said that creeds represent milestones set up to mark the points

where people stopped thinking. This is true in science in the same way that it is true in theology. It is easier to accept an assumption than to question it, and the average student will almost invariably prefer the text or author that presents him with conclusions in dogmatic form to the one that presents complex data and conclusions with modifications and questions. Success in the study of human nature will not result from an implicit acceptance and mechanical application of assumptions, however natural it may be to follow that course. Much of the work with mental tests has led to unsatisfactory results because of blind faith and inadequate analysis of results. The entire educational system suffers from the application of untested dogmas, and conditions can be improved only by the acceptance on the part of teachers of a critical and experimental attitude, because most of the assumptions on which the educational process is based are as yet very insecurely established by scientific data.

This digression and warning is deemed necessary in connection with the endocrine glands to prevent a too implicit acceptance of the results and especially of the inferences presented. If the student objects to the mental attitude thus enforced, he may be reminded that the situations of actual life are not of such a character that they can be met successfully by the application of fixed formulæ in mechanical fashion. Analysis of situations and revisions of principles and attitudes are constantly necessary. Success or failure in doing this is the final test of the intelligence of the individual.

With the foregoing reservations the writer attaches great importance to the attempt to analyze some, at least, of the aspects of human character in terms of internal secretions. It is not to be expected that such an analysis will permit of dividing an ordinary group into a number of distinct types. All of the glands are more or less essential

for normal life and the removal of any one of a number of them will cause death. They represent an interacting system of variables and all that we should expect would be that in some cases there would be a domination of the others by one or two glands while in the average case the functional efficiency of all of the glands would be more or less balanced.

Naccarati and Guinzberg have analyzed the relation between intelligence and the ratio of height to weight, and they find some indication that the tall, thin individual is somewhat more likely to be intelligent than the short, stout individual.[6] Since these bodily differences are known to be greatly influenced by internal secretions, it is evident that mental differences also produced by internal secretions may be associated. As we shall see later, however, stature depends in part on hereditary factors independent of the glands of internal secretion. From this it will follow that at best the relation between stature and intelligence is a slight one. Some imbeciles are tall and some people of genius are short. Heidbreder (1926) studied the relation between height-weight ratio and intelligence-test scores in a group of one thousand college students and failed to find any significant correlation between body build and intelligence.[7] It is, of course, possible that a study of an unselected sample of the general population would show a different result, but under the circumstances Naccarati's conclusion can hardly be accepted without further evidence.

Anabolism

Finally it should be pointed out that the efficiency of both the nervous system and the glands of internal secre-

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[6] S. Naccarati and R. L. Lewy-Guinzberg, "Hormones and Intelligence," *Journal of Applied Psychology*, Vol. 6 (1922), pp. 221-234.

[7] Edna Heidbreder, "Intelligence and the Height-Weight Ratio," *Journal of Applied Psychology*, Vol. 10 (1926), pp. 52-62.

tion depends on the assimilation of food. The animal mechanism cannot do efficient work for very long without food and sleep. If there is a deficiency in the quantity or quality of the food or in the mechanism of assimilation or in the opportunity for sleep or in the ability to sleep, the entire system will begin to weaken. Some of the differences between individuals must, therefore, be ascribed in part at least to differences in the vegetative system. Energy must be assimilated before it can be expended.

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CHAPTER III

AN ANALYSIS OF THE INDIVIDUAL

Before we can hope to get very far in the discussion of individual differences, it is necessary for us to analyze the individual into different traits, tendencies, capacities, or other simpler and more elementary units, because an individual is far too complex to be discussed as a whole, and an attempt to compare different individuals without first making such an analysis would lead to considerable confusion. We shall, therefore, consider in what respects that would be significant for psychology one individual may differ from another.

PHYSICAL TRAITS

Outer Physical Characteristics

In the first place, we may note that all we can observe of a man at rest is his external physical characteristics: his size, his form or proportion, and his color (skin, hair, eyes). But are these characteristics in any way significant to psychology?

As we have started out to study the psychology of individual differences, it may seem that our attention should be confined to the study of inner and more purely mental traits. From the discussion in the last chapter, however, it is apparent that at least some physical characteristics have a great deal to do with our mental characteristics. And if we stop to consider the matter we will realize that even such a thing as mere physical mass may have important psychological effects.

Size, as a matter of fact, often has considerable psychological influence. The large man or woman, *ceteris paribus,* is taken more seriously than the smaller representatives of the species. We speak of "men of weight" and of "weighty" opinions and in other indirect ways show that we are impressed by size. And the bearing of some "men of weight" shows that they are in thorough agreement with the popular view. Very small men, on the other hand, not infrequently develop compensatory tendencies to make up for their size.

Certain tendencies such as aggressiveness and submissiveness are naturally likely to be influenced in their development by the physique of the individual. Pugnacity is not likely to thrive in a small body. As James points out, the unsuccessful fighter will stop carrying that line of goods.

Form and proportion of the body in somewhat similar way react on the psychic life of the individual. The society beauty often has her disposition badly warped as a result of becoming too conscious of her superior appearance. The homely individual, on the other hand, is forced to develop more durable attractions.

Form and proportion do not permit exact measurement with the same ease as general bodily size, but in a general way their importance is evident in social behavior.

Color of hair, skin, and eyes is so closely linked up with certain broad racial differences that it has on that account considerable effect on the psyche. Race consciousness is usually rather strong, and differences in skin color have considerable influence in determining our social reactions. Color of hair and eyes, though relatively less important, at times has marked influence in determining individual reactions.

If one considers that these things are of no psychological importance, let him imagine that on first looking in the

mirror some morning he found his skin color changed to that of another race. Consider for a moment the social and individual psychological consequences!

It is perhaps worth mentioning that clothes, ornaments, and other accessories have an important place in the total picture, but as they are not a permanent attribute of the individual they may be passed over here.

Inner Physical Differences

Differences in inner physical characteristics that are psychologically important may be divided into those of structure, balance, health, resistance, strength, and metabolic ratio.

Structure.—Structure is important because it is the first essential fact of sex differences. Aside from this, however, there is little if anything that need be pointed out. If we were dealing with pathological conditions, various abnormalities, including tumors, might be mentioned; but these will be passed over here.

Balance.—By balance is meant the ratio between the sizes or functions of the different organs. With proper balance no organ will do too much or too little for the rest of the body. A small heart is a source of weakness and danger and may result in undesirable psychological conditions. An overactive thyroid leads to an excitable mentality that is unfortunate for the individual and for his associates as well. Biology is not yet in a position to analyze in detail the balance of organs in different people, but we have made enough of a beginning in that direction to realize something as to the importance of the problem.

Health.—Freedom from the discomforts and disabilities of disease is clearly of great psychological importance. It is a matter of many degrees and the deviations from it involve many complex combinations. This is indicated by the specialists in modern medicine. We can appreciate

in a general way its importance without the necessity of dealing in detail with its variations.

Resistance.—Resistance to disease, though closely related to health, may be considered independently of it, because one may keep well by avoiding disease germs or, if one has the necessary resistance, one may to a considerable extent ignore the danger of disease. Directly this may be of little or no psychological significance, but indirectly it has a vital effect on our mental life.

Strength and Endurance.—Strength and endurance may have considerable effect on an individual's reactions. The person with little of these qualities is unlikely to be particularly active and energetic in doing anything unnecessary. Exceptional achievement requires exceptional work, and so the man who is physically incapable of prolonged effort is relatively unlikely to achieve great superiority.

Susceptibility to fatigue also has an important bearing on emotional disposition. The tired man is generally thought of as cross and irritable, while the rested man is considered typically more cheerful. Strength and endurance may thus be vital factors in determining the emotional life.

Metabolic Ratio.—For want of a better expression, the ratio of the anabolic or building-up processes to the katabolic or tearing-down processes is called the *metabolic ratio.* During the period of growth anabolism is greater, but its proportion to katabolism declines progressively throughout life. The rate of this change is expressed in the first part of life by the rate of growth and in the last part of life by the rate of involution or disintegration. Only the growth process has received much study, but we know that there are individual differences in the rates for both ends of the life cycle.

The relation between rate of physical growth and rate

of mental growth is not entirely clear, but the problem is important and should not be overlooked.

NATIVE PSYCHO-MOTOR TRAITS

Turning to the characteristics of the individual that are more essentially psychological, it will be convenient to designate our second group of characteristics as *psycho-motor*. Conscious or mental seems to relate possibly too much to the subjective states, and as we desire to include the motor aspects as well, such terms are hardly suitable. Psycho-motor appears, however, to cover the desired field. For convenience, the psycho-motor field will be divided into two groups: the native and the acquired.

Classification of Psycho-Motor Characteristics

Into what units shall we analyze the psychological traits of the individual? If we followed the extreme behaviorists, we should content ourselves with an analysis of reactions and so would have much to say about reflexes and their conditioned variants. Or we might follow the introspective school and make our analysis in terms of sensations, images, affective states, with perhaps elementary feelings of relationship or of the self added. Or we might follow the *Gestalt* school and think of the mental life of the individual in terms of functional units and purposes. Turning to the mental testers, we might follow the view of Spearman and hold that the mind is an aggregate of specific capacities or "engines" that are driven by a common central energy which is switched from one to another. Or again, there is the view of Thorndike that the native traits consist of a large number of specific and more or less independent capacities and tendencies.

There is doubtless an element of truth in all of these views, contradictory though some of them seem. The out-

line presented here makes no attempt to follow any of these in detail but borrows from such as appear to offer useful ideas.

Sensory Capacities

The starting point of a reaction is a stimulation of a sense organ. The content of consciousness depends on what has come through the senses. But sensations depend quite as much on the inner mechanism as on the external stimulus. A stone is not sensitive to light, though the same ether vibrations may strike it that strike the human eye. There is, then, a capacity for stimulation which is essential as a basis of vision. In the normal human eye there is the capacity for two kinds of sensations, the achromatic and the chromatic. The achromatic are divided into the black, the white, and the intermediate grays. The chromatic series is divided into red, green, blue, and yellow. These last are paired, with the first two, red and green, composing one pair, and the last two, blue and yellow, composing the other pair. That these two pairs are to some degree independent is shown by the facts of color blindness, in which normal vision for red and green is lacking. Furthermore, there are variations in the differences in the shades and tints of colors that can be perceived by different individuals. Such differences, then, would seem to be the natural starting point for the psychological study of individual differences.

In the same way we could follow the analysis made by the physiologists and the experimental psychologists and break up the auditory, gustatory, olfactory, cutaneous, and kinæsthetic sensations into the elementary kinds. We shall assume, however, that the reader is already acquainted with these facts. All that it is desired to point out here is that differences in sensory capacity may be the foundation of very important mental differences.

Congenital blindness and deafness will necessarily result in a marked difference in mental content.

Imagery

Most individuals have, to some degree at least, all of the sensory capacities mentioned above. The capacity for reviving these sensory qualities without the customary objective stimulus is, however, not so general. Apparently there are much wider variations in imagery than in sensory capacities. Some people claim that they have no imagery at all. Others have good imagery in certain fields with poor imagery in other fields. Even in a particular field, such as audition, it may happen that a person has excellent imagery for one kind of material and very poor imagery for a different kind. He may recall digits and be unable to recall musical notes. There are thus many possible variations in the imagery which different individuals may be able to command.

Our thinking involves the use of images to a considerable extent, and the character and results of thinking may thus be determined in large measure by our capacities in that direction.

Associational Capacities and Tendencies

Whether there is a distinct element in consciousness of a relational sort the writer does not pretend to know. It is evident, though, that our thinking is a process of associating things and relating them in different ways. We do associate and relate and there must, therefore, be capacities for that sort of thing. There appear, also, to be distinct tendencies to form relations of particular kinds. Parents of children from four to six years of age are well acquainted with the attempts at mental organization made during that period. The endless requests for explanations are an indication of associative tendencies that require the assumption

of something of that kind in the native make-up of the child. Differences in intelligence and differences between normality and insanity are often to be stated, in part at least, in terms of the mental management of relationships. On the physical side there is an excellent basis for these differences in the variations in the complexity of the terminations of the dendrites and axones. Added to this would be such differences as exist in functional efficiency.

Affective Capacities

Not only do we become aware of certain things and relate them in many ways, but we feel them as pleasant or unpleasant. And these feelings are a very important part of our mental life. There are certain uniformities in such matters, but there are also important differences. Sweetness is generally pleasant and sourness is generally unpleasant. But some people show a strong liking for sour things. Some of these differences are largely due to environmental influences, but some of them cannot be satisfactorily accounted for in that way. Apparently there are certain native likes and dislikes, and this means that pleasantness and unpleasantness are natively associated with those things.

Some people are characteristically more cheerful and optimistic, while others are characteristically more melancholy and pessimistic, and these differences would appear to involve differences in the general affective background of consciousness. This is probably one of the essential differences between the so-called sanguine and melancholic temperaments.

The affective capacities are of further importance because of their impulsive character. What is pleasant is sought after and what is unpleasant is avoided. This is said without any idea of accepting these as the sole regulators of conduct. It is desired, however, that the importance of

differences in affective capacities be recognized. If one man develops a liking for alcoholic drinks and another one does not do so, it may make a marked difference in the later activities of the two.

Complex Mental Processes

The capacities and tendencies listed above may be regarded as more or less elementary. Much of the discussion of individual differences has, however, been in terms of combinations of these. Emotion, attention, perception, imagination, memory, and reasoning are examples of complex mental processes which are dependent on complex capacities and tendencies, though they are often spoken of as if they were simple.

Emotion.—In terms of the James-Lange theory an emotion is a complex of organic, kinæsthetic and cutaneous sensations. Since an affective tone would also be present, we might say that an emotion is a complex of sensation and affection. Ordinarily it is probable that the effects of past experience will also be involved, and so it is necessary to add images to the list. Simple emotions are, then, rather complex.

Fear and anger are examples of simple emotions. They are simple in the sense that a characteristic reaction occurs in response to particular stimuli without any particular training. An unexpected fall will usually result in the internal bodily changes and the mental states called fear.

There are also complex or compound emotions which consist of combinations of simple emotions. Examples of these are awe and reverence. Such emotions depend on previous experience and will vary according to the character of the previous experience.

Attention.—Attentiveness is a complex of clearness, an affective tone of pleasantness or unpleasantness, and an impulsive tendency to adjust the senses and muscles with

reference to the thing attended to. It depends first on the reflex and instinctive tendencies but later is modified by habit and by acquired interests. From a practical viewpoint attention is much influenced by the presence or absence of distracting stimuli. What is attended to and with how much concentration it is attended to will then depend on a variety of factors.

Perception.—The student acquainted with elementary psychology will have no particular difficulty in recognizing the complexity of the perceptual process. Thus the perception of an orange may be analyzed into fruity odor, sweet and sour taste, yellow and possibly red color, pleasant affective tone, and various other sensory elements, images, associated meanings, etc. The perceptual abilities involved in listening to an orchestra are evidently very different from those involved in studying a planet through a telescope.

Imagination.—In the sense in which imagination is generally used, it covers any kind of new combination of the materials of past experience. Its possible complexities are thus limited only by the amount, variety, and quality of these materials. One individual with good visual and kinæsthetic imagery will naturally have an imagination very different from that of an individual lacking in those capacities.

Memory.—What has been said of imagination applies largely to memory as far as complexity is concerned—with the important limitation, however, that memory is confined to the reproduction of actual experiences. Even so, it should be clear that there is no single memory capacity, but that there is a possible memory for each kind of elementary conscious experience. A total memory experience may consist of a wide variety of elements.

Reasoning.—Reasoning is essentially a process of making new combinations of mental material so as to solve a

problem. Naturally, then, the character of the process will depend on the character of the imagery and the associative tendencies available. In any particular case, the result will depend not only on the native tendencies involved but also on the experience of the individual. One may have all the necessary native equipment for solving a problem in celestial mechanics, but unless he has had the requisite training in mathematics and physics he will be unable to make the actual solution. In the study of geometry it seems probable that kinæsthetic and visual imagery are most useful if not actually necessary. The person who is good in those directions will find the learning of geometry easier, but to solve a particular problem in geometry it is necessary to have a knowledge of the geometrical principles involved in the solution. The native abilities involved in learning the last part of geometry will be the same as those involved in learning the first part, but in addition there will be the necessity of knowing the content of the first part of the course. Such an illustration should make it clear that there is no such thing as a general reasoning ability. The requirements for reaching a solution of a particular problem are specific, and it may happen that a student is well equipped for solving certain problems but is entirely unable to solve other problems. It may be justifiable to speak of "reasoning ability" as if it were a unit, but it is quite essential that the student recognize that this is not literally correct.

Intelligence

As used here, intelligence means capacity for learning. The student who is able to learn a given lesson better or in less time, *ceteris paribus*, is more intelligent than his fellow.

In recent years much has been said of general intelligence. Some have understood this to mean an ability to

deal with all kinds of material equally well. It must be evident, however, from what has already been said, that such a view is inconsistent with our position as to the nature of mind. There is no such thing as general intelligence. If we use the term, and it is a convenient term to use, it must be understood simply as an average of our various abilities. If we had the necessary figures at hand, we might speak of the average altitude or elevation of the United States. This would not mean that the entire country was a smooth surface. In the same way we may speak of general intelligence without implying that all abilities are equal. Only in that sense will the term be used here.

Mental testers have come to use general intelligence rather specifically as the thing measured by the different tests which have been developed for the especial purpose of predicting success in school work. Such a use is dangerous if not intelligently understood. General intelligence, thus used, means particularly the abilities involved in the use of language. There are other kinds of ability that are equally as important. Any classification, however, will be open to objection, because there is no very natural system into which the various abilities may be grouped. With this objection in mind, for convenience in discussion, we shall divide intelligence into four groups of abilities: abstract, mechanical, social, and artistic.

Abstract Intelligence.—School work, as stated above, is based mostly on the ability to use symbols in the form of language or mathematics. Great ability in language may exist without great ability in mathematics, but in general these abilities are rather closely correlated. Both kinds of ability, however, represent a combination of specific abilities. Arithmetic, geometry, and algebra require different abilities, but because they are often found together it is convenient to speak of mathematical ability as if it were

a unit. An analysis of a number of group intelligence tests will show that the score depends primarily on language and mathematical abilities, and an analysis of the scores made on each test in the group tests will show that the correlation between the tests is far from perfect. At times we find students making high scores on language tests and doing good work in philosophy and sociology or other rather abstract subjects but at the same time making low scores on mathematical tests and doing poor work in case they are required to take courses in mathematics. This shows clearly that correlation does not mean causal connection in this case. There are various kinds of abstract intelligence.

Mechanical Intelligence.—Ability to learn algebra or to write a poem or to memorize an oration has no necessary bearing on ability to take an automobile apart and put it back together so that it will run. Ability to manipulate things, to handle machinery, or to construct things is an independent kind of ability. The carpenter, the plumber, and the automobile mechanic require more of this kind of ability and less of what we have called abstract intelligence. Mechanical ability is itself complex and a person well adapted to handling one kind of machinery may not be particularly successful in handling another kind.

Social Intelligence.—Social tact and the ability to understand and deal with other people are sufficiently different from other abilities to justify a separate classification. A high order of abstract intelligence may go with widely different degrees of ability to understand people. Social intelligence depends partly on what we have called abstract intelligence, but it depends to a greater extent on the emotions and sentiments. The relative development of sympathy and altruism on the one hand and of ego-centric selfishness on the other hand will have much to do with social reactions. There are no satisfactory tests at present for this

kind of ability, but we have sufficient evidence to justify its separate classification.

Artistic Intelligence.—Music, painting, sculpture, architecture, and literature require a very varied group of abilities, but all are alike at least to the extent of involving an appreciation of beauty. No proof is necessary to secure recognition of the fact that musical ability is largely independent of other abilities such as we have listed under abstract, mechanical, and social intelligence. The same holds for painting. Idiots-savants have shown remarkable ability in painting and very little ability along other lines. The literary genius may be very weak along some lines. Because of the fact that these abilities are not very closely related to school work, little attention has been given to them by the mental testers; but they represent such an important part of our lives that it would not be justifiable to omit them from our classification.

Moral Intelligence.—Some will doubtless hold that we should add moral intelligence as a fifth variety. If anything were to be gained by such a classification it might well be resorted to, but all moral capacities can be reduced to the abstract, the social, and the artistic groups already listed. For that reason we omit it here.

Reactions

Native reactions are of two kinds: reflexes and instincts. All other reactions are based on these, being either modifications of them or combinations into some new form. From this it follows that the acquired reactions will show much greater individual variation than the native ones.

Reflexes

With the development of objective psychology in recent years, the reflex has acquired a prominent place in psychology. The studies along that line are not yet to the

point, however, that we can make any great use of them in a discussion of individual differences. But in comparing low-grade mental defectives and normals or in comparing some varieties of insanity with normality they are of great value.

Instincts

The instincts, taken in conjunction with the emotions, are of the utmost importance in understanding human nature and conduct. Unfortunately, though, the whole question of instinct is at present too unsettled to admit of a very definite use of instincts in discussing individual differences. If, as McDougall holds, there are a number of elementary instincts which vary in strength in the general population according to the normal frequency curve, we should have an excellent basis for understanding differences in character and conduct. But satisfactory measurements of differences in instincts in different individuals are not available and we are forced to depend on rather general observations. The whole matter is further complicated by the fact that in man instincts rarely exist in pure form but are usually modified in various ways by experience. Admitting these difficulties we may, nevertheless, hold to the importance of instincts in determining individual differences.

Observations of young children show differences in temperament that cannot be explained satisfactorily by environmental influences. Some children are strongly inclined to be pugnacious; others show very little tendency in that direction. Some children show great timidity and fear, while others are bold and relatively fearless. Some children are very self-assertive, while others are much more submissive. These differences often happen in the same family where the treatment has been very similar. On the ground of such observations reinforced by general principles, the writer agrees with the view held by McDougall that the

instincts may be expected to vary according to the normal probability curve. This affords a more satisfactory basis for explaining individual differences in character than any other view now available. When we add to this original difference the effect of environmental modifications, we have all that is necessary for a complete explanation.

ACQUIRED PSYCHO-MOTOR TRAITS

All acquired traits or characteristics are to be regarded as modifications of native traits or as being based on native traits or capacities. Therefore, it becomes necessary to keep in mind that whenever individual differences are credited to the influence of the environment there is an underlying native factor that may be quite as important or perhaps on occasion more important than the environmental one. Nothing, it may be repeated, is exclusively either native or environmental. But certain characteristics show more directly the influence of the environment and so are classified as acquired.

Knowledge

Outstanding among individual differences are differences in knowledge. It is quite impossible to make the experiences of two people exactly the same. Differences in environment guarantee differences in knowledge, and this necessary difference is further increased by differences in interests and in abilities. The possession of knowledge along particular lines has its own effect on interest and on the acquisition of further knowledge, and so a difference that was originally small may become a great one. These facts are so obvious that they will not be elaborated here.

Meanings, Attitudes, Beliefs, Sentiments, Ideals

In addition to the knowledge acquired from the environment there is a group of as yet unmeasurable characteristics

that are of very great importance in determining the personality. Without any special attempt at a rigid classification these may be designated by the terms: *meanings, attitudes, beliefs, sentiments,* and *ideals.*

Ten people may learn to recite a poem so that all say the same words, but it is very unlikely that any two of the ten will attach the same meaning to the poem. Differences in meaning for the same words are well shown in the widely different interpretations given to the Bible. Many religious denominations profess to believe the Bible and to accept it as the basis of their creeds, yet we find them making the same words mean very different things. In the same way other experiences are given meanings varying with different individuals.

Attitudes, like meanings, are extremely variable. Likes and dislikes of many degrees and kinds are felt by different people towards the same person or idea. These and other attitudes make up an important part of meaning.

Belief is essentially an attitude, and as we recognize there are all kinds and degrees of beliefs. Some people believe in fortune telling, others laugh at the idea. Some believe in one God, others believe in many gods, others in none at all. The influence of these and other beliefs is sufficient to make very great differences in the conduct of individuals. Columbus believed the earth was round and the result was the discovery of a New World.

Sentiments may be classified, according to McDougall, into those of love, hate, and self-respect. What we love, what we hate, and how and for what, and to what degree we respect ourselves are vital factors in determining what we are and do.

Ideals combine to a considerable extent all of the things listed in this group. They are especially important in that they represent the goals towards which our activity is directed. If we could cause identical twins to have different

ideals, it could very easily result in the making of two very different men. In practice there is likely to be a vital relation between native characteristics and ideals, but once the ideal is adopted it results in the neglect or suppression of some native tendencies while others are cultivated and strengthened. A man might well have the capacity to be either a great soldier or a great preacher, but under the circumstances he can hardly be both, and the adoption of an ideal to be one will ordinarily cause thoughts of the other to be abandoned.

Religions, Customs, and Conventions

Social psychologists emphasize the importance of religious beliefs, customs, and conventions in determining the mental make-up of the individual. This emphasis is justifiable, but on analysis it will be seen that these aspects of the personality are included in the traits already mentioned. No distinct classification is necessary.

Acquired Motor Reactions

Learned motor activities may be classed as habits and skills. Habits would cover the group, but the use of skills is justifiable to emphasize the skilled aspect of many motor habits. Playing the piano, playing tennis, writing, dressing, eating, doing carpenter work, driving an automobile, and a vast number of other more or less complex activities involve the development of motor coördinations through practice. These constitute a very important part of the individual's accomplishments, and no description of the individual's traits would be complete without them. Learning a trade is largely a matter of the acquisition of such skills, and they enter to a great extent even in activities far removed from the trade classification. A surgeon must have acquired great motor skill along particular lines. The research chemist or physicist or physiologist requires con-

siderable manual skill to carry out his experiments. We may not be able at present to measure these exactly, but we can at least recognize their importance.

MENTAL UNITY

A final characteristic of the individual to be considered is that of organization. Thus far we have dealt with more or less separate and discrete elements of mental make-up, but we must not make the error of concluding that such an analysis gives a complete picture. One might study every part of an automobile without getting a clear conception of the machine as a whole. To do that it is necessary to see the whole in action. The same applies in principle to man but with an important difference. The automobile is a mechanical unit; man is an organic unit. The interrelations of parts in man are more complex and more important than in a machine. Also man is conscious and has purpose which the machine lacks.

Objectively it is, of course, possible to consider man as a machine governed purely by physico-chemical forces. At present, however, such a method cannot carry us very far. And even if it were completely successful, there would still be a place for a consideration of the subjective and personal aspect of conduct. It is the latter side which we wish to emphasize here.

It is human nature to strive for certain ends. If a goal is reached, another one is promptly set up. If a goal is found to be unattainable, the normal course is to shift to another and more attainable one, but this normal shifting is not always found. Here is the basis of much mental pathology.

Marked individual differences are found in the character of the goals that are set up. Some set up remote and difficult objectives, others set up easy and near ones. This

is, of course, partly a matter of mental level or maturity. Some settle definitely on a dominating goal or purpose, others hesitate between several purposes, and still others pursue one aim for a brief time and then readily turn to another one, only to give it up for a new one, and so on for an indefinite series.

The objectives a person strives towards and the interrelationships existing between his purposes determine in large measure the character of his mental activity and his conduct. It is these that give unity and coherence. These are the determining factors in voluntary action.

An Outline for the Study of the Individual

Physical Traits	*Outer*	Size: height and weight Form or proportion Color of hair, skin, and eyes
	Inner	Structure Balance Health Resistance Metabolic balance
Psycho-Motor Traits	*Native*	Motor capacities: strength, speed, accuracy, resistance to fatigue, handedness Sensory capacities: cutaneous, kinæsthetic, etc. Affective capacities and tendencies Reflexes Instincts Emotions Attention Images and imagination Perception Memory Associative tendencies and capacities Reasoning Intelligence: abstract, mechanical, social, artistic

Acquired Habits and skills
Knowledge
Purposes and ideals
Meanings and attitudes
Mental unity and balance

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CHAPTER IV

THE MEASUREMENT OF MENTAL TRAITS

Failure of Historical Methods of Diagnosing Ability

The fundamental aim of mental diagnosis is prediction. Men desire to be able by observing certain signs, symptoms, or performances to predict how an individual will act at some future time. Among primitive peoples and even yet among some moderns whose intellectual outlook is still primitive, the attempt is often made to predict a person's future by considering the stars or consulting other signs and omens. Many daily papers still carry in their columns horoscopes which foretell futures according to birthdays. It is possible today by dropping one cent or perhaps a dime in a slot to receive a printed analysis of your (?) character. Fortune tellers prosper.

From the discussion of the relation between mental and physical traits in Chapter II, it should be evident that diagnosis of character and prediction of conduct cannot succeed even when based on attempts at science such as palmistry, graphology, physiognomy, or phrenology. It is conceivable that at some future date some slight significance may be attached on a scientific basis to the characteristics of the hand. At present, however, works on palmistry should be catalogued as fiction and not as science. Graphology has some claims to consideration as a basis of determining mental traits, because it has been shown that a few people are able to tell from handwriting something as to a person's character. But such capacity must be considered an art rather than a science, because no principles have yet been established by which writing may be scientifically

interpreted. The average individual is unable to use handwriting as a basis of character judgment. There is no *science* of graphology. Physiognomy is in somewhat the same position as graphology. A few people do appear to have the ability to tell something from features and from photographs as to a person's character and abilities. When submitted to a scientific test, they show considerably better than chance success. But here again they are unable to formulate and establish any principles by which others can attain the same result. The average individual is able to tell but little about character and less about intellectual ability from seeing a person or seeing his photograph. Some even tend to judge the opposite of the truth. Physiognomy is not a science, nor is there reason to believe it can ever be the basis of the kind of predictions which have been attempted by those using it. At best the correlation between facial traits and mental traits is probably too low to be useful. A distinction must, of course, be made between the direct observation of expression and the prediction of behavior from anatomical traits. If we see a person in anger it will usually be expressed by the face, but we are unable to determine by looking at the face at rest to what degree and by what stimuli anger may be aroused. This is the real problem.

Phrenology has even less to offer than palmistry, graphology, or physiognomy. There is a slight correlation between brain size and intelligence, but it is worth recalling that Pearson found a slightly higher correlation between eye color and intelligence. In neither case is it significantly high. Brain localization of the kind postulated by the phrenologists does not exist. Save in a few distinctly pathological cases, therefore, phrenology has nothing at all to offer.

The conclusion to which we arrive when we review the evidence for and against the various methods of estimating

ability and character which have been used up to recent times is that they are of little or no value and that none of them are on a scientific basis.

The Basis of Modern Mental Measurements

Our present methods of measuring ability and character are derived mostly from two sources: experimental psychology and statistical methods.

From physiology the experimental methods were brought over into psychology. At first they were applied chiefly to the study of sensations and reactions, but their use has been extended until all kinds of mental processes have been so investigated. Mental tests are in reality experiments.

Statistics have supplied the methods of treating and interpreting the results of experimental investigations. This is quite as essential as are the results themselves.

From the foregoing it naturally follows that the best training for the mental tester is to be found in courses in experimental psychology and statistical methods. To these must, of course, be added courses in mental testing. The present chapter attempts to provide a brief survey of mental measurements with the object of supplying the beginning student with the background necessary for the understanding of the test results bearing on the problems of individual differences.

MEASUREMENT OF SIMPLE MENTAL TRAITS

To illustrate the methods used in measuring simple mental traits we shall describe briefly some experiments on sensation, motor reaction, and memory.

Visual Acuity

The subject may be seated in a well lighted room in such a position that a test card can be placed in a good light at

a distance of 20 feet in front of him. The eyes are tested separately, one eye being covered while the other eye is tested. Various kinds of test cards are used, the Snellen being perhaps most commonly used. This consists of letters of different sizes which should normally be read at different given distances. If the subject, using the right eye, is just able to read the 20 foot line, being at the time at a distance of 20 feet from it, his vision is said to be 20/20 or normal with that eye. If he can read no further than the line that should be read at 15 feet, his vision is 15/20 or below normal. If he is able to read the line normally read at 25 feet his vision is better than average or 25/20. The other eye may then be tested in the same way. Such a method affords an objective determination of the acuity of vision.

Speed of Tapping

How fast is an individual able to tap with a pencil or other instrument? The simplest method of determining this is to take a pencil with a medium point and make dots on paper, scattering the dots sufficiently so that they can be counted. This may be timed with an ordinary watch with a second hand, though a stop watch is much to be preferred. The stop watch will measure to fifths or smaller fractions of a second. If the subject begins at a signal and stops at a signal and taps for ten seconds the average number of taps per second will give a reasonably accurate index of speed of reaction for this kind of movement. For adults the rate of tapping will average about six or seven taps per second. In psychological laboratories more elaborate apparatus is used for this experiment.

Memory Span

Suppose it be desired to know a person's memory span for digits or other material. Either visual or auditory

presentation may be used. For the auditory method with digits, make up series of numbers of from 4 to 12 digits each. There should be about 3 numbers of each length. Digits should be arranged in chance orders but avoiding natural sequences such as 3, 4, or 7, 8, and preferably even reversed sequences such as 6, 5, or 2, 1. The digits should be read at a uniform rate by the experimenter and without any cadence or grouping. As soon as each number is completed, the subject should attempt to repeat it. The average for adults is about 6 or 7 digits. Very few make less than 4 or more than 9.

The object in these and other tests and experiments is to secure results which are accurate and reliable. If this is done they represent the subject's real capacity in the thing tested. The more objective the methods used, the more likely the results are to be reliable.

TESTS OF GENERAL INTELLIGENCE

The Binet-Simon Test

The mental-testing movement may be said to have received its most important stimulus from the work of Binet and the three forms of the test published by him in 1905, 1908, and 1911. Before that time important work had been done by Galton in England and Cattell in America. The experimental psychologists had laid the foundation for mental testing and it was only a question of time until the movement would develop great importance but Binet did much to hasten the spread of the movement.

Binet was asked by the school authorities in Paris to develop a test which would enable them to separate the feeble-minded from the normals. He had had some fifteen years' experience as an experimental psychologist and had already shown an interest in the experimental study of in-

telligence. He was, therefore, eminently fitted for the task at hand.

Binet began by making out a series of exercises or questions which he thought might prove to be tests of intelligence. His list contained 100 of these. He did not, however, label this list of questions as an intelligence test and proceed to give it to children and on such a basis diagnose them as normal or defective without further investigation. Laymen often get the idea that intelligence tests are thus constructed. A professor of education is said to have remarked once that a psychologist will make out a list of questions and make sure that he can answer them himself and then call the list an intelligence test. Such, however, is not the case if the psychologist is a reputable one and follows scientific methods. What Binet did was to test his supposed test. He did this by trying the list of questions on two groups of children. One group was known to be normal or superior because of their school performances. The other group was known to be inferior or feeble-minded. Binet compared the answers given to his questions by these two groups of children, and when he did not find that a question served to differentiate the two groups he rejected the question as a test of intelligence. As a result he rejected 67 of his original 100 questions. The remaining 33 had been found by actual experimentation to be answered poorly by the defectives and well by the normal and superior group. These 33 problems or questions were arranged in order of difficulty from easiest to hardest and a child's intelligence score was the number of questions answered correctly. This was the form of the 1905 test.

Binet revised his test and introduced the concept of mental age. Each test was tried on normal children of different ages and it was found possible to place a test in an age group so that children of the age lower than that would mostly fail on the test, a majority of those of the age in

question would pass the test, and nearly all of the ages above would pass the test. Take, for example, the test of giving the family name. Most children of 2 years would fail on the test. They did not know their family name. A majority of the children of 3 years could answer the question correctly, and nearly all of 4 years or more could answer it correctly. For this reason the test is called a 3-year test. In the same way other tests are found which are especially adapted to each year. The general plan was to have 5 tests in each year. If a child passed all of the tests in the 6-year group and failed in all above that year, he was said to have a mental age of 6 years regardless of what his actual chronological age might be. This mental age of 6 years simply meant that he had succeeded in solving the same number of problems solved by the average child of 6 years in the group on which the test was standardized. Another group of 6-year-old children might have shown a different result. In fact, in time it became apparent that there were differences of some importance between the children in Paris and those in the rural districts.

Because of these differences in different groups of children, it was necessary to extend the observations by means of which the test had been standardized. Binet engaged in such work and in the development of new tests until his death in 1911. A final revision of the test was published shortly before his death. As an example of their nature a list of the tests for 3, 9, and 15 years is given:

Age 3:
1. Points to nose, eyes, and mouth.
2. Repeats 2 digits.
3. Enumerates objects in a picture.
4. Gives family name.
5. Repeats a sentence of 6 syllables.

Age 9:
1. Gives change from 20 sous (cents).
2. Defines familiar words in terms superior to use.
3. Names the common coins.

4. Names in order the months of the year.
5. Answers easy "comprehension questions."

Age 15:
1. Repeats 7 digits.
2. Finds 3 rhymes for a given word.
3. Repeats a sentence of 26 syllables.
4. Interprets pictures.
5. Interprets given facts.

In order to pass the first test in the third year it is only necessary for the child to know the meaning of the words *nose, eyes,* and *mouth.* Every child with ordinary sensory capacities in an ordinary environment has the opportunity to learn the meaning of these words. If he does not do so by the time the average child learns them, it is an indication that his learning capacity is below average. If he learns them sooner, it is an indication that his learning capacity is better than average.

The second test requires memory, and memory is obviously necessary for intelligent action.

In the third test a picture is shown and the child is asked to tell what he sees in it. If he enumerates spontaneously 3 objects in one picture, he passes the test. The pictures relate to ordinary life and so do not depend on any special opportunity or training. Like the first test, however, they involve language.

The fourth test, giving the family name, is another language test.

The fifth test, repeating a sentence of 6 syllables, is a test of memory involving previous experience with language.

Language, it will be seen, is a very important factor in these tests. But language is a very important factor in school work, and so it is necessary to test language ability, if we are to be able to predict ability to do school work. Other abilities are also tested so that the test does give a good indication of ability in general. We shall not analyze the tests further at this point.

Simon, a psychiatrist, was associated with Binet in the development of the test, but because of the greater importance of Binet's contribution the test is rather generally known as the Binet test.

Revisions of the Binet Test

The first revision of the Binet scale made in America was in 1911 by Goddard, then psychologist at the Training School for the Feeble-minded at Vineland, N. J. Goddard translated the French version into English and adapted it to American conditions.

In 1915 Yerkes, Bridges, and Hardwick published a revision of the Binet test that involved two important modifications. In the original Binet, the scoring was on the all or none principle. A test was passed with full credit or else no credit was given. In some cases this principle seemed to be unsatisfactory. One test, for example, consisted in asking the child to name all the words he could in 3 minutes. To pass the test he was required to name 60 words. If he named 59 he failed, so there was no difference between naming 10 words and naming 59; neither was there any difference between naming 60 words and 120 words. Yerkes and his collaborators changed the method of scoring and put it on a point basis. In the test just mentioned credit was given as follows: 30 to 44 words, 1 point; 45 to 59 words, 2 points; 60 to 74 words, 3 points, 75 and up, 4 points. Other tests were scored on a point basis in the same way so that the score on each test indicated more accurately the quality of the answer.

The second change from the original Binet consisted in discarding the grouping of tests by ages. Instead, age norms were determined by finding the average number of points made by children of a given age. Then if a child made a particular number of points and it happened that the average for 10-year-old children was the same, his mental

age was said to be 10 years regardless of his chronological age.

A further revision of the Binet scale was made by Terman at Stanford University. This was published in 1916 and is known as the Stanford Revision of the Binet Scale. A number of modifications and improvements were included in the Stanford Revision. New tests were added so as to provide 6 for each of the lower ages from 3 years up. Alternative tests were also supplied to be used in case the regular tests could not be given. Additional tests were added at the upper end of the scale. After 10 years there were tests for 12, 14, 16 (called "Average Adult"), and 18 (really extending to 19½ years and called "Superior Adult"). This work was so well done that it has come to be the standard of comparison. The upper part of the scale is, however, necessarily inferior to the lower part, because it was not so well standardized. This will be discussed in a later chapter.

In order to express the relation between mental age and chronological age, Terman took an idea due originally to Stern and incorporated it in his method. The value resulting from dividing the mental age by the chronological age was called the *intelligence quotient,* usually abbreviated as I.Q. It was found by experimentation that, within certain limits, this ratio remained practically constant. If, therefore, a child of 4 had an I.Q. of 125 it was possible to predict his mental age at the age of 10 years or other age. By simple proportion it is shown to be 12.5 years or 12 years and 6 months. This was a tremendous step in advance. This is the greatest achievement of mental testing from a scientific point of view and it is also the point which has been most bitterly opposed by the believers in the force of environmental factors in determining mental capacity. For the I.Q. to remain fixed it is, of course, necessary that environmental influences be without appreciable influence

in that direction. To accept the I.Q. is essentially to accept the idea of mental inheritance.

Important revisions of the Binet scale have also been made by Kuhlmann and by Herring, but the Terman revision remains the most widely used of the individual tests.

Group Tests

Group mental tests have come into common use as a result of their use on the American Army during the World War. Before the War, intelligence tests were being adapted to administration as group tests. The great difficulty, however lay in the time and effort required to score the tests as usually given. For group tests to be used extensively it was necessary that the scoring be made simple and objective. The most important of the early contributions in this direction was made by Otis. Otis showed how it was possible to eliminate nearly all writing in taking a test and to make the scoring of a test so simple and so objective that it could be done by any person with ordinary intelligence and with little special training in intelligence testing.

The practical stimulus to the wide use of tests, as stated above, came with the attempt to devise tests which could be given to the men in the Army and used as a basis of classification. Obviously, if several millions of men were to be tested, they could not be given individual psychological examinations by trained experts in mental measurement. It was necessary to examine them in groups and have the papers scored by clerical assistants. The test devised to meet this need is known as the Army Alpha.

Army Alpha is a battery of 8 different tests. The different tests are: (1) Following Directions; (2) Problems in Arithmetic; (3) Common Sense; (4) Opposites; (5) Disarranged Sentences; (6) Number Series; (7) Similarities; (8) Information. The character of the tests will be illustrated by sample items from Form 6.

Item 1 of the Directions Test had 5 circles in a row on the test blank. The directions are "Make a figure 2 in the second circle and also a cross in the third circle." There are 12 items in this test. The last item has the numbers 1, 2, 3, 4, 5, 6, 7, 8, 9 on the test blank and the directions for it are: "If 4 is more than 2, then cross out the number 3 unless 3 is more than 5, in which case draw a line *under* the number 4."

The second test consisted of 20 arithmetic problems involving only a knowledge of the fundamentals but requiring correct reasoning. These range from very easy ones to some that are rather difficult. No. 16 will illustrate the test: "If a train goes 200 yards in 10 seconds, how many feet does it go in a fifth of a second?" The answers to these problems are placed in column at the right side of the page so that they can be checked by comparing with a set of correct answers on a slip of paper. The score is the number correct. No attention is paid to errors.

The test of common sense has 16 different items. No. 8 is:

It is better to fight than to run, because
cowards are shot
it is more honorable
if you run you may get shot in the back

The correct answer is indicated by placing a check mark before it.

Test 4 consists of 40 pairs of words, some of which mean the same thing and some of which mean the opposite. Each pair is followed by the words "same—opposite," and which they are is indicated by underlining the correct word. This is essentially a test of vocabulary.

Test 5 contains sentences with the words in irregular order, as "cows milk give" and "external deceptive never appearances are." Following each disarranged sentence are the words "true—false." Whether the sentence with the

words in correct order is true or false is indicated by drawing a line under the correct word. There are 24 of these sentences.

Test 6 contains number series such as the following:

2	3	4	5	6	7	..	..
6	9	12	15	18	21	..	..
1	4	9	16	25	36	..	..

The series is to be extended to the next two places in each case.

Test 7 contains problems of this kind:

1. dog — bark : : cat — *chair mew fire house*

The problem is to find out how the first two words are related and then find the word of the last four which is related in the same way to the third word. In this case *dog* is to *bark* as *cat* is to *mew*. So the word *mew* is to be underlined. There are 40 of these problems.

Test 8 contains problems such as the following:

1. Boston is in *Connecticut Rhode Island Maine Massachusetts*

29. Rubber is obtained from *ore petroleum trees hides*

The answer in each case is indicated by drawing a line under the correct word. There are 40 of these problems.

The total number of items in the entire test is 212. Each separate test is given with a time limit. The time limits vary from 1½ minutes to 5 minutes.

It will be seen from this brief description that the method used permits a rather wide survey of different abilities to be made in a brief period of time. And the papers can be scored in a perfectly objective and uniform way.

During the past few years the market has been flooded with imitations of Army Alpha. To make a group test is very easy, but to make a good one is very difficult. It is

not, therefore, surprising that tests which have appeared overnight or as a result of very limited study should have proved in many cases to be virtually worthless. What is needed is not more tests so much as a more thorough study of some of the tests at hand.

Performance Tests

Army Alpha requires ability to read on the part of the person taking the test. Many soldiers could not read English and many could not read any language. For these, a different test was needed. Beta, a performance test, was devised to meet this requirement.

The principle of Beta may be illustrated by the Picture Completion Test. This consisted of pictures from which some part was missing, for example, a face minus a nose, a rabbit with only one ear, a revolver without a trigger, etc. The missing part was to be determined and indicated on the picture. Skill in drawing was not required. Tests of this character can be explained without the use of language and so may be used for the deaf or for those of foreign tongues as well as for those who do not read English but who speak it.

Tests of Ability in Special Subjects

Tests like the Binet, Alpha, and Beta are intended to give an estimate of what has been called general intelligence. Actually the Binet and Alpha tests measure rather more closely what we have called abstract intelligence and are especially related to conventional school subjects. There are, however, considerable differences between the abilities required in different subjects. Students excellent in mathematics may be poor in languages and vice versa. Some attempts have been made, therefore, to develop tests which would measure the abilities required to do particular kinds of work. This is a very promising field of investigation

and in time we should have reliable tests to diagnose the abilities of individuals for different subjects.

Tests of Other Abilities

In analyzing intelligence we divided it into abstract, mechanical, artistic, and social. The tests so far discussed relate primarily to abstract intelligence. Some attempts have been made in the other fields also. Stenquist has developed tests for mechanical aptitude. Seashore has developed tests for musical ability. Downey has developed tests for the will-temperament. An increasing variety of tests is appearing in these and related fields. Social and moral traits are being analyzed and measured, though the accuracy of these measurements is at present inferior to that with which more purely intellectual traits are measured. It is too early to pass judgment on the value of the recently developed tests for measuring character traits.

Rating Scales

Mention should be made here of the plan devised to secure more accurate ratings of men in different qualities. For rating Army officers, Scott devised the plan of having the raters select from a number of the men of their own rank the best one, the poorest one, an average one, and intermediate ones between poorest and average and between average and best. In rating officers of lower rank the officer being rated would be compared with the officers set up as examples of different degrees of military efficiency and would be given a numerical grade according to the kind of officer he promised to be. By comparing each officer with the same group of officers it was found that much more uniform results were obtained.

The same general plan of rating may be used for any kind of trait and may be expressed conveniently by having a line drawn to represent the range of the quality from low

to high degrees. The grade assigned to an individual may in such case be indicated by placing a check mark on the line or scale opposite the degree of the trait which the person is judged to possess.

STATISTICAL METHODS OF TREATING TEST RESULTS

To understand the results of mental tests some knowledge of statistics is necessary. In biology, psychology, and education, when dealing with measurements of physical and mental traits, most statistical work is related in one way or another to what is variously known as the *normal curve of distribution*, the *normal probability curve*, or the *curve of error*. It is, then, necessary to get acquainted with this curve before going farther.

The Normal Probability Curve

If we make a large number of measurements of the length of a table and make them as accurately as possible, we shall find that our measurements do not agree. Some will be larger than the others and some will be smaller. Most of the measures, however, will be grouped rather closely together. If, instead of using a measuring stick to determine the length of the table, we were to ask a large number of persons to guess the length, we should find greater differences between the high guesses and the low ones, but again most of the measures or guesses would be grouped closely together. Generally speaking, the greater the error in the guess above or below the correct measure, the smaller would be the number of persons making the guess. The hypothetical distribution of a large number of guesses in such a case is shown in Figure 8. Because errors in measurement were found to be distributed like a bell-shaped curve, this curve was called the curve of error. Now it happens that, if, instead of measuring one table a large

number of times, we take a large number of men selected at random and determine the height of each in inches, we again find that most of the men are grouped rather closely together in height, though a few are very tall and a few are very short. If we find the average height of the group to be 69 inches, most of the men will be near that height. Very few will be above 75 inches or below 63 inches. The farther a given height is above or below the average, the smaller will be the number of adult men of that height.

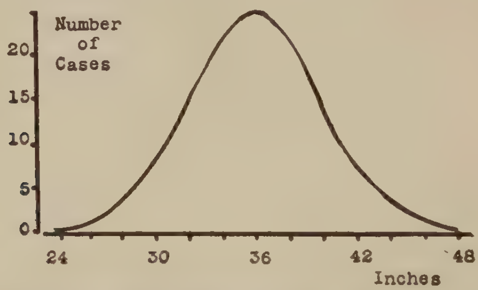

FIG. 8.—A HYPOTHETICAL DISTRIBUTION OF THE GUESSES THAT MIGHT BE MADE BY A LARGE NUMBER OF PEOPLE IN GUESSING AT THE LENGTH OF A TABLE 36 INCHES LONG.

The height of the curve above the base line shows the number of guesses.

The similarity in the form of the distribution for height and other physical measurements to the curve of error caused some thinkers to consider the average as the ideal and the deviations from this as errors on the part of nature. The tall man and the short man were thus mistakes on the part of Dame Nature. We do not view the matter just that way at present and so we do not often use the expression *curve of error* in connection with human traits. Rather, since the probabilities are that the measurements of a single trait in a large number of individuals selected at random will be found to be distributed more or less closely

like the bell-shaped curve, we usually call it the normal probability curve or the curve of distribution. A hypothetical distribution for the heights of a large group of men is shown in Figure 9. As we shall see in later chapters, many mental traits show the same kind of distribution.

Statistical Measures

In describing an actual distribution mathematically, it is necessary to know the central tendency or average and to know the extent to which the distribution is spread out

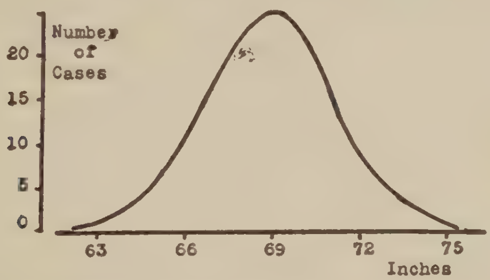

FIG. 9.—THE NORMAL DISTRIBUTION OF THE HEIGHTS OF THE MEN IN A POPULATION IF THE MEAN HEIGHT IS 69 INCHES AND THE σ IS 2.7 INCHES.

from the average. This is known as *variability*. Frequently it is desirable to compare two sets of measurements made on the same individuals and see how closely they are related. We might, for example, determine the height and the weight for a group of individuals and see how closely height and weight are related. Such measures are known as *correlations*. And last but by no means least, it is necessary to have a measure of the reliability of each of these measures; because, while the average height of a group of men may be correct for that group, when we use it as a generalization for men as a class we cannot be sure of it, and when we make a single measure of the mental

ability of an individual we cannot be sure that the measure is accurate. Hence, it is necessary to know not only the measure itself but also its *probable error,* as these measures of reliability are called.

Measures of Central Tendency

Three kinds of measures of central tendency are used: the *mean,* the *mode,* and the *median.* The word *average* is at times used as a general term to include all three of these and it is also used at times as a synonym of mean. Its use in the broader sense is likely to be misleading at times, because in our arithmetic we have learned a special meaning for the term. It is, perhaps, better to use *central tendency* as the general term, and, to avoid confusion, to discontinue the use of average unless it is specially defined. When used in this book it will mean the same as the mean.

The Mean.—The mean is found by dividing the total of the measures in a group by the number of cases. It is probably the most commonly used measure of central tendency but is laborious to compute when dealing with a large number of cases. When the number of cases is small, the mean is at times objectionable, because it may be greatly influenced by a small number of extreme deviations.

The Mode.—The mode may be found by a special mathematical procedure, but this use of it need not concern us. In the more common usage it means the most common measure in the distribution. If the distribution is symmetrical, the mode will be the same as the mean; but in irregular distributions the mode is a convenient measure of the major group in the distribution.

The Median.—When convenience with reasonable accuracy in the determination of the central tendency is desired, the measure most commonly used is the median. By definition this is the middle of a series of numbers. If we think of it in relation to the scale of the normal dis-

tribution, it is the point on the scale above which and below which 50 per cent of the cases fall. It is not influenced by extreme deviations and so will at times be a more accurate measure of central tendency than the mean. In a normal distribution based on a large number of cases the mean and the median fall at the same point, though in any particular set of cases a small difference will usually be found. If the distribution is irregular or if the cases are massed towards one end of the distribution (skewed), there may be a considerable difference between the median and the mean. In such a skewed distribution the median falls between the mode and the mean.

Measures of Variability

Norms, standards, or averages may be very misleading if not accompanied by some measure of variability. Two populations might have the same per capita wealth, but all of one population might be on practically the same financial level, while the other population might vary widely from extreme poverty to extreme wealth. Or comparing two grades in school by means of intelligence tests, it might be found that both groups had a median mental age of 10 years: one group might be very homogeneous and the other might vary from much lower to much higher mental ability, and in such a case the teaching problem would be very different for the two classes. The most common measures for representing this variability of a distribution are the *quartile deviation* (*Q*), the *standard deviation* (*S.D.*, also represented by the Greek letter *sigma*, σ), and the *average deviation* (*A.D.*) or *mean deviation* (*M.D.*).

The Quartile Deviation.—The quartile deviation is found by the formula $\frac{Q_3 - Q_1}{2}$ in which Q_3 represents the point on the scale below which 75 per cent of the cases fall and Q_1

represents the point below which 25 per cent of the cases fall. Q represents, then, a distance laid off on each side of the median so that one-half of the cases in the distribution are included in the space thus delimited. The greater the variability of the group the larger is Q.

Like the median, the quartile deviation is easily determined and is useful where a quick and fairly reliable measure of variability is desired.

There is also another measure of variability, the *probable error* of the distribution ($P.E.$), which is found by a different method but ordinarily has about the same value as Q. Care should be used not to confuse this probable error with the probable errors of measures to be discussed later.

The Standard Deviation.—The standard deviation is the square root of the sum of the squares of the individual deviations from the mean divided by the number of cases. By the long method the mean of the distribution is first found. The deviation of each measure from the mean is determined. These deviations are squared and summed, and the sum is divided by the number of cases, and the standard deviation is the square root of the result. This is the most important measure of variability, because other measures of variability may be calculated from it and it has other important uses. Between the limits of 1σ above and below the mean, 68.26 per cent of the cases are included.

The Average Deviation.—The average deviation is found by finding the mean of the distribution, finding the deviation of each measure from the mean, summing these deviations without regard to sign, and dividing the total by the number of cases. This is not a very convenient or useful measure, but it is often met and should be understood.

Measures of Relationship

It is often desired to compare two sets of measures of the same individuals, as for example, comparing the grades

of a French class for the first and second semesters of the year. If the number of cases is very large, it is impossible for an individual to compare such records with any accuracy unless he resorts to graphical or mathematical meth-

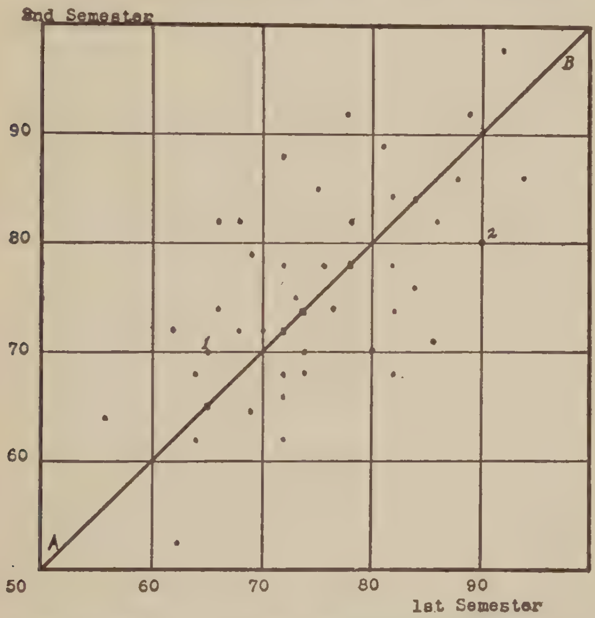

FIG. 10.—THE RELATION BETWEEN THE FIRST AND SECOND SEMESTER GRADES OF 45 STUDENTS IN FRENCH (HYPOTHETICAL).

Each dot represents a student. The dot at 1, for example, means that the student in question received 65 the first semester and 70 the second semester. The dot at 2 shows that this student received 90 the first semester and 80 the second semester.

ods. Figure 10 shows the method of representing in graphical form such a relationship. If the agreement between the grades of the two semesters were perfect, *i.e.*, if the students received exactly the same grades both semesters, all of the cases would fall on the line *AB*. When a correlation

is expressed in numerical form, perfect positive correlation is expressed by + 1.00. Actually, of course, such a perfect agreement between term grades is rarely if ever found.

Suppose a second case in which no relationship existed between the grades of the two terms. Under those conditions it would not be possible from knowing a student's grade in one semester to make any prediction as to his work in the other semester. This would be indicated graphically by a wide spreading of the cases on the chart. Instead of being on or close to the line of perfect correlation, they would be scattered practically over the whole chart. Such a correlation is represented mathematically by 0.00, or by some figure approaching zero.

In a third instance suppose we plotted the relation between ages and intelligence of first-year high-school students, and suppose it happened that the youngest pupils were the brightest, the oldest ones the dullest, and the others were similarly in opposite positions in the two distributions. If all the cases fell on the line *CD*, as illustrated in Figure 11, this would be an example of perfect negative correlation and would be described mathematically by a coefficient of correlation of —1.00. Actually such perfect negative correlations will rarely if ever be found, but negative relationships of less degree are found, and these mean that those who are better than the average in one trait will tend to be poorer than the average in the second trait, though not to the same degree. The size of the correlation is a measure of the degree of agreement or, in the case of negative correlations, of disagreement.

Correlations are ordinarily determined by mathematical methods. The most generally used method for finding the relation between two variables is the product-moment method of Pearson, in which the coefficient is represented by r. Other coefficients may be represented by R or by other

symbols. The student interested in the details of such methods is referred to works on statistics.

Partial Correlation.—Suppose we compare the grades of students in Latin and Spanish. It may happen that the

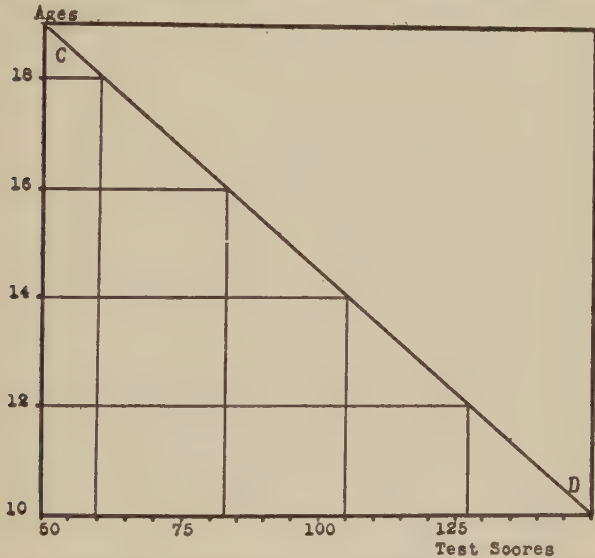

FIG. 11.—CHART TO ILLUSTRATE THE MEANING OF PERFECT NEGATIVE CORRELATION.

If a group of students aged 10 to 19 years made scores of from 50 to 150 on an intelligence test so that when the scores were plotted all of them fell on the line *CD*, this would show perfect negative correlation. This would mean, for example, that those aged 18 would receive scores of 60 and those aged 10 years would receive scores of 150. In practice a perfect negative correlation of this kind would never be found for a large group, but there is a negative correlation between age and test scores in any particular year of school.

correlation between them is very high. Does this indicate that the high marks in Spanish are caused by the superior knowledge of Latin? Or may it be due to some other factor, such as intelligence? To determine this we need to

eliminate the influence of differences in intelligence or hold intelligence constant in making the comparison. This is known as finding *partial correlations.* In the case in question, if we partialed out or eliminated the effect of differences in intelligence, we should find the correlation between marks in Latin and marks in Spanish much lower than when calculated directly by the product-moment method.

Multiple Correlation.—If we gave a class a group intelligence test containing 10 different tests and we desired to find a combination of tests that would give the highest correlation with work in a particular subject, for example, algebra, we would find the correlation of each of the 10 tests separately with algebra and then probably reject all but 2, 3, or 4 of the tests showing the highest correlations. If we desired to get the highest possible correlation between a combination of the remaining tests and the marks in algebra, it would be necessary to weight the scores in the separate tests so as to make some of them count for more than others. This process, known as *multiple correlation,* need not be explained here, but the student should be aware of the existence of such a method.

Measures of Reliability

In studying many problems statistically it is necessary to take a sample of the thing studied rather than study all of the cases of the thing in question. If, for example, it is desired to know the average height of the men in New York City, no one would suggest that all of the men be measured. Such a procedure, if carried out, would indeed give a result which would be accurate for the time at which the measures were made. But such accuracy would be attained at too great a cost of time and labor. In practice we would select a limited number of men, several hundred or several thousand, as a sample of the total adult male population and base our conclusions on the selected group.

Under such conditions there will be some error in the result. Only by chance will such a procedure give a result the same as that found by measuring the entire population. It is necessary, then, to have not only the measure itself but also to have a measure of its reliability or probable error.

Errors of Selection.—Whenever a selected group of cases is made the basis of a generalization, there are two distinct kinds of errors of selection that may be made. In the first place, a group may be measured which does not give a random sample of the larger group but which is itself the result of selective agencies of a particular sort. Prejudice or emotional bias may be at the basis of such unfair selection, but very often unknown or unsuspected selective factors have operated. Statistical literature is filled with this particular kind of error. A good example is found in comparisons that have been made of students who have taken the Latin course in high school with students who have taken the commercial course. If an intelligence test is given to both of these groups, it will usually be found that the Latin group makes the higher score. From this it has at times been concluded that Latin "improves the mind" more than the study of commercial subjects improves it. This conclusion is based on the assumption that at the beginning of the courses the two sets of students were of equal capacity. This assumption, however, turns out to be false. The Latin course operates as a selective factor and when a mental test is given to students *beginning* the study of Latin and the study of commerce it is found that the Latin students make the better score. The difference between the groups exists, then, both before and after the study of Latin, and to credit the difference to the effect of the study of Latin is to disregard selective factors.

In dealing with questions where the conclusion must be reached by a consideration of complex data, it is possible to prove almost anything if we select our cases with

proper care. Every care must therefore, be used to see that the cases selected as a basis of a generalization are a fair and random sample of the total group.

If the utmost care is used in avoiding the effect of special selective factors, there will, nevertheless, be more or less error due to chance variations in the cases selected. The nature of this kind of variation can be best shown by reference to experiences common to players of card games. In auction bridge, for example, when the cards are shuffled and dealt according to the rules, the resulting distribution of the cards is a matter of chance. No factor of unfair selection has come in and yet there is the greatest diversity in the hands received by different players at the same time and by the same player at different times. In a similar way, if we select a limited number of cases as a sample of a group of variable phenomena, there will ordinarily be a difference between the mean or other measure for the sample and the true value for the entire group. This is an error to which all statistical work is subject when the measures are used as generalizations, and for that reason special formulæ have been developed for calculating the probable errors of the different measures.

Probable Errors of Statistical Measures.—Attention may be called here to the formulæ for the probable errors of five different measures:

$$P.E. \text{ of } M. = .6745 \frac{\sigma}{\sqrt{N}}$$

$$P.E. \text{ of } M.D. = .8454 \frac{\sigma}{\sqrt{N}}$$

$$P.E. \text{ of } \sigma = .6745 \frac{\sigma}{\sqrt{2N}}$$

$$P.E. \text{ of the difference between } M_1 \text{ and } M_2 = \sqrt{(P.E. \text{ of } M_1)^2 + (P.E. \text{ of } M_2)^2}$$

$$P.E. \text{ of r} = .6745 \frac{1-r^2}{\sqrt{N}}$$

For our present purposes it will suffice to illustrate the use of the probable error of the difference between two means. Suppose, for example, we are comparing the average scores made on an intelligence test by 25 12-year-old boys and by 25 12-year-old girls. The mean score for the boys we shall assume to be 65 and that for the girls 70. Is this a significant difference? Suppose the value of σ in each case to be 15. By the formula, the probable error of the mean in each case is 2. From this the probable error of the difference between the two means is found to be 2.8. Sound statistical practice requires a difference in such a case to be 4 times the probable error of the difference. In this case the difference, 5, is less than twice its probable error and so is not safely to be regarded as significant. Only when based on a number of cases large enough to reduce the probable error of the difference to 1.25 or less would such a difference be considered significant.

Measurements of individual differences, if considered as generalizations, always involve probable errors, and the student should form the habit of thinking of statistical results as involving possible fallacies due to unfair selection and probable errors due to accidental selection. Furthermore, instruments of measurement have themselves probable errors. When a mental test is given to a number of children, the results do not give exactly the mental capacities of the individuals tested. In group tests of intelligence, especially, the probable error is relatively large and the results are consequently to be interpreted with considerable care and caution when applied to individual cases. Failure to consider the importance of the probable error of mental measurements has at times resulted in gross injustice. This is, in fact, one of the chief objections to having group intelligence tests used by untrained psychologists.

A mental test may be inaccurate for two reasons: a single application of the test will not ordinarily agree exactly with

other applications of the same test or of other forms of the same test, and the average of a number of measurements by the same test may not give an accurate measure of the thing which it is desired to measure. The first difficulty can be overcome to a considerable extent by giving a child a different form of the same test after an interval of several weeks. The second difficulty requires fundamentally an improvement of the test itself but may be overcome in practice to a considerable extent by giving a different group test after a short interval.

A practical illustration will show the importance of considering the probable error in interpreting the results of measurement. Suppose a boy is examined with a group test and is found to have a mental age of 10 years. Suppose the probable error of the test is 6 months. There is then a 1 to 1 chance that the true mental age of the boy is between 9½ and 10½ years—and there is an equally good chance that his true mental age is not within those limits but is either above or below them. Taking a distance of 2 *P.E.* from 10 years, the chances are about 9 to 2 that the true mental age lies within the limits of 9 and 11 years. There is about 1 chance that it is above 11 and 1 chance that it is below 9 years to the 9 chances that it is between 9 and 11. There is some chance even that the true mental age is still farther removed from 10 years, but the probability decreases rapidly as we get farther away from the measure found. With well standardized individual tests the probable errors may be considerably less than 6 months, but with some of the group tests on the market the probable errors are quite probably much larger than 6 months.

The chief moral to point from this discussion is that conclusions not based on a large number of carefully made measures should not be taken too seriously. Generally speaking, statistics based on less than 30 cases do not deserve to be considered as offering anything more than a

suggestion as to what might be found if a larger number were studied, and it is quite within the limits of probability that the suggestion in such cases will turn out to be misleading.

GENERAL CONSIDERATIONS REGARDING TESTS

Validity

A test is usually devised for a particular purpose. It may be desired to measure a particular ability. When the test is devised it is quite likely that it will only partly measure the ability in question and will partly measure other abilities. If there is any accurate and certain criterion or standard with which the test may be compared, it is easy to determine the extent to which the test agrees with it; but often there is no satisfactory criterion available. This is the case with general intelligence. Psychologists do not agree as to what general intelligence is, partly perhaps because general intelligence is a convenient fiction without actual existence. Aside from this, however, we have no way of knowing precisely the intelligence of an individual, so when we get a measure of the individual's intelligence we do not know whether the measure is valid or not.

Reliability

A second difficulty is encountered in the fact that if a test is given to an individual twice, with an interval between, or if two different forms of the test are given at different times, it is found that the two results do not exactly agree. If we measured the same plank with the same measure and found that at one time it was 5 feet long and at the next time it was 8 feet long, we should feel that something was radically wrong. Yet we sometimes find results just as discordant as this when we repeat cer-

tain mental tests. The better standardized tests will at least agree very well with themselves, whether what they measure is known exactly or not. The novice at mental testing is very likely to assume that the tests are both perfectly valid and perfectly reliable when, as a matter of fact, they are neither. Failure to recognize this fundamental point may easily lead to serious errors in judgment.

The Speed Factor

Much criticism has been heaped on tests of the Alpha variety because of the time limits. It is maintained that with more time the "slow and careful" workers could have made a much better score. This was tested by giving the test with twice the regular times and comparing the results with the scores obtained with the standard times. The average scores were, of course, somewhat higher, but the relative ranks of the different individuals were but little affected. In general it is found that the most intelligent individuals tend to be also the most rapid workers and the least intelligent ones tend to be the slowest workers. When, therefore, group tests are used for purposes of rough classification, no serious objection can be raised to the time limits imposed. At the same time it should be noted that great speed and a high level of ability are not very closely associated. There are some individuals—not as many, indeed, as popular opinion supposes but nevertheless a few—who are slow but very intelligent, and a speed test will give an entirely incorrect measure of their ability. For this reason it would be better if methods were devised of measuring speed of work as a separate factor.

Difficulty of Tests

The Binet tests present a series of tests of different degrees of difficulty. What can just be done by the average child of 4 is obviously more difficult than what can just be

done by the average child of 3. There is, however, no basis in the Binet scale for determining the quantitative relation between these degrees of difficulty. We are not, for example, justified in saying that what a child of 8 years is barely able to do is just twice as difficult as what a child of 4 years is barely able to do.

In group intelligence tests of the Alpha variety the problems of each test range from easy ones to difficult ones. The intention is to provide some tests so easy that all who take the test will score something and to make some tests so difficult that none will get all correct. It would be desirable at times to have a test which would measure level of ability rather than speed. In practice our group tests combine both of these.

Units of Test Scales

In measuring lengths of objects we use such standard units as the inch, foot, or meter. In measuring mental traits we are at times confronted with the fact that we have no satisfactory unit of measurement. Some mental capacities can be measured on an objective scale. Sensory capacities can be compared with the objective stimuli. Motor reactions can be measured in an objective way so as to determine speed, strength, and accuracy. Memory can be measured against objective units, such as numbers of digits. In attempting to determine the relative difficulty of different problems, however, we have no such satisfactory objective basis. Some number combinations, such as 9×7, are more difficult than others, such as 4×2, but we are unable to state readily from objective evidence and in terms of an objective scale precisely what the difference is. In group mental tests we may know that some problems are more difficult than other problems, but we do not know just what the difference is. This is a matter of great importance. We cannot determine the form of the

distribution of a trait unless we know how the units in a scale compare. In practical work, when we are dealing with an apparently unselected group, we may determine in an approximate degree how satisfactory our scale is by the form of the distribution it gives. If the scale is properly graduated, a normal distribution will result. If it is not properly graduated, a skew distribution will result.

The most important contribution to this problem has been made by Thorndike, Bregman, Cobb and Woodyard. After careful experimentation these workers conclude that the errors resulting from measuring a trait in a single individual a large number of times will be distributed symmetrically according to the normal curve of error. Hence it becomes possible to use the distributions resulting from repeated measurements of the same person or even from one measurement of a large group of individuals of approximately equal ability as a basis of grading a test scale. By determining the mean and standard deviation of the distribution of such a group of measures it becomes possible to equate with considerable accuracy the units from 1 *S.D.* above to 1 *S.D.* below the mean. By taking a number of overlapping groups the scale can be extended beyond the limits of the one group. This method has been applied in a preliminary way to several of the existing intelligence tests so that we now have more accurate scales.

In some instances the plan suggested by Woodworth of using the probable error or the standard deviation of the distribution as the unit of measurement may be used as a partial solution of the problem. In this case the average is considered zero and the deviations are listed as so many plus or minus probable errors or as standard scores.

One of the difficulties encountered when we attempt to treat the data of mental measurements mathematically is the location of a true zero of ability. The importance of this may be illustrated by comparing the average scores

made by the soldiers from two different states during the War. One state had an average score of about 40 points and the other state had an average score of about 80 points. Now a school child will say that the arithmetic of the case is simple: one average soldier has twice as much intelligence as the other average soldier. Yet such is not the case, because a zero score on the test used does not represent a real zero of mental ability. Suppose we add 100 points to each average and then we have 140 and 180. This changes the relative position of the two on the scale, but it does not change the absolute difference between them in points. In this case the writer guesses that the real relation is more nearly what we should have if we added 120 to each average so as to give 160 and 200 or a ratio of 4 to 5. For all we know at present, the true relation might be that found by adding 200 points to each average so as to give 240 and 280 or a ratio of 6 to 7. Certainly there is a vast difference between a ratio of 1 to 2 and a ratio of 6 to 7. Until we know the zero of our scale is the real zero of ability, we are not able to engage in mathematical comparisons and keep out of trouble.

The conclusion to be drawn from all this is not that the facts secured from mental measurements are of too uncertain meaning to be useful but rather that caution and statistical insight are necessary in using them if one will avoid serious misinterpretations.

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CHAPTER V

THE NATURE AND EXTENT OF INDIVIDUAL DIFFERENCES

Traits as Specific

As has already been set forth in earlier chapters, the writer assumes that the mind can be analyzed into a number of specific traits and functions. The general result of scientific investigation has been to reduce to smaller and smaller size the units which it regards as fundamental. This is an almost necessary result of the analysis which attends investigation. The ordinary individual may regard the mind as something of a unit, but on scientific investigation it breaks up into a number of smaller units. At the present time the most satisfactory analysis of these mental units would seem to be in terms of specific sensory capacities, specific imagery capacities, specific affective capacities, specific muscular and glandular capacities, capacities for connecting in specific ways these sensory, affective, and motor capacities into larger units, and tendencies to connect specific stimuli with specific responses.

The analysis of the mind into such specific units has been rendered difficult because of the fact that ordinarily the mind works as a functional unit and our attention is normally directed to certain goals and objectives rather than to the processes of the mind itself. It is, therefore, not a simple matter to pay attention to these customary objectives and at the same time to analyze the processes themselves by a process of introspection. In the case of emotional disturbances the difficulty is greatest, because the emotion dissipates as one attempts to analyze it.

It is, of course, possible to develop a psychology almost purely in terms of function and without special consideration of the structural units of mind. Such a psychology may be more immediately practical and more useful for certain scientific purposes also, but in the nature of the case it is less fundamental than an analysis in terms of structural units. These, after all, are the units that function. In considering the nature and extent of differences we shall, therefore, be concerned primarily with the problem as to how elementary capacities and tendencies may vary rather than with the variations of a functional order such as are considered by the *Gestalt* and psychoanalytic schools. These have been discussed at some length by other writers.

Kinds of Individual Differences

As a matter of logical classification we may classify individual differences as qualitative and quantitative. Differences of a quantitative character might be so distributed in the population that all of the members of the group would form a continuous distribution varying from one central tendency, or they might form a number of distinctly separate groups each varying about its own central tendency. Conceivably there might also be other possible distributions, but we do not need to consider them.

Qualitative Differences

Under what conditions do we find differences between individuals of such a character that it may be said that one man possesses a trait of which another man has none at all? Under such conditions, do we find that the man without any of the trait has a certain amount of another trait instead? These are the two questions of greatest importance in discussing qualitative mental differences.

In answer to the first question it is possible to point out

many examples of the absence of a trait in particular individuals. In the field of sensation we may find the loss of practically any kind of specific capacity. Loss of cutaneous sensitivity is relatively rare but is found in certain forms. Kinæsthetic disturbances are more common. Loss of sensations from the semicircular canals is common in cases of deafness. Loss of muscle, tendon, and joint sensations is a characteristic symptom of tabes dorsalis. Loss of taste is very rare, but loss of smell is more common. The best known disturbances of sensory capacity are, however, in the fields of sight and hearing. Congenital blindness is not uncommon, relatively speaking. When vision is present there may be night blindness, or either total or partial color blindness. The partial color blindness affects only the capacities for sensing red and green. In the field of hearing, we find total deafness and tonal deafness and tonal gaps. In tonal deafness there is inability to discriminate different pitches, and with tonal gaps there is inability to make such discriminations within a limited range of vibrations.

In the field of central processes we find somewhat the same general situation as exists in the sensory field. A great variety of capacities may be missing. There may be inability to form any particular kind of image. Some even claim that they have no imagery at all. The loss of imagery necessarily involves the memory. Specialized defects of memory are found.

A familiar illustration of the loss of a central function is found in aphasia. The aphasias may be either sensory or motor. In sensory aphasia there may be either the loss of ability to understand printed symbols or to understand spoken words. In motor aphasia there may be loss of ability to speak or to write. Apparently any of these special abilities may be lost without any of the others being greatly involved.

According to the results of some tests of particular cases of insanity there is apparently the almost complete loss of power to form associations.

Some at least of the instincts and emotions may be lost. The sex instinct depends on the integrity of the sex glands, and the removal of the gland at an early age will prevent the development of sex instincts and emotions. In lower animals there are even cases of change in sex as a result of disease of sex organs. This suggests a change in the character and quality of the sex instinct and emotion. Here, then, in comparing males and females it may be that we have a truly qualitative mental difference which cannot be described satisfactorily simply as a case of loss; though genetically, as we shall see later, it may be possible to describe the difference between the sexes in quantitative terms —partly at least.

Another difference in central processes which might at first be considered as a qualitative difference is found in the synæsthesias. Colored hearing, in which colors are associated with tones, occurs apparently in something like 5 per cent of the population. The experience which people with this capacity get is different from that which others get, but the difference is one of combination and not a difference due to the presence of anything which is itself new. It is not, therefore, strictly speaking, a qualitative difference. Those who have number forms have an even simpler combination. It is something that could probably be learned by almost anyone with good visual or kinæsthetic imagery.

On the motor side there may be losses of different capacities ranging from the loss of control of a few muscles to the loss of control of the entire muscular system. Peculiar combinations of movements may be found, but there is nothing really new, *i.e.*, of a qualitative sort.

The nearest approach to a qualitative difference in the

motor field is found in right- and left-handedness. This can be given a purely quantitative description in terms of the relative amounts of strength and skill possessed by the two hands, and so for that reason we shall treat it later in connection with quantitative differences.

The conclusion at which we seem to arrive is that all real qualitative differences between individuals, with the possible exception of sex feelings, may be reduced to the absence in some individuals of traits which are normally possessed by others. In no case excepting sex feelings would it appear that there are alternative capacities or tendencies which are mutually exclusive so that only one may be possessed by a particular individual. It is, of course, recognized that an individual can have only one degree of a particular trait. This may, on account of our terminology, give the appearance of alternative traits, as if we say that a person cannot be both a genius and a mental defective. Speaking more correctly, however, we would only be saying that a person can have only one level of mentality.

Quantitative Nature of Individual Differences

The natural conclusion from the foregoing is that, with the possible exception of certain sex differences, all mental differences are of a quantitative character. If for convenience we suppose the mind to consist of 100 or any other number of specific traits, we should find it possible to describe the differences between any two individuals by comparing the amounts of each trait which each person has. Most individuals would have at least a small amount of each trait, though in some cases the amount would be zero. On this basis the study of individual differences resolves itself into the determination of the extent of differences in single traits and of the ways in which different amounts of single traits may be combined in the same individual. The

latter problem will be discussed in Chapter XVII. The former problem will be discussed in part in the present chapter and will be discussed in certain aspects in greater detail in later chapters on extreme deviations.

TABLE I

DISTRIBUTION OF ABILITY IN ADDING PAIRS OF ONE-PLACE NUMBERS IN HIGH-SCHOOL PUPILS

From Thorndike after Courtis. The smoothed frequency values are added by the writer.

Quantity: Number of Pairs Added in 60 Seconds	Frequency in High-School Pupils	Frequency after Smoothing Once	Frequency after Smoothing Twice
20- 29	2	3	7
30- 39	4	16	24
40- 49	41	53	70
50- 59	113	142	134
60- 69	272	207	194
70- 79	235	234	204
80- 89	196	172	171
90- 99	86	108	108
100-109	43	44	56
110-119	2	16	21
120-129	2	2	7

Extent of Individual Differences in Single Traits

In discussing the extent of individual differences in single traits it would be possible to consider mankind as a whole and simply point out the extent of deviations in the entire group. There are, however, certain biological groups, those due to age, sex, and race, which deserve separate treatment. We shall accordingly consider in later chapters any differences due to age, to sex, and to race. We shall be concerned here with the general problem of the extent of differences without reference to the differences based on such biological distinctions. All that is desired at this point is to acquaint the student with examples of the extent of

differences so that he will be in position to form a better general idea of individual differences as a background for the discussion of more specialized problems.

Methods of Representing Frequency Distributions

The distribution of a set of measures may be presented in either tabular or graphic form. As an example of tabular presentation the distribution of ability in adding pairs of 1-place numbers in high-school pupils is shown in Table I. From the table it appears that 2 pupils added from 20 to 29 numbers, 4 pupils added from 30 to 39 numbers, etc.

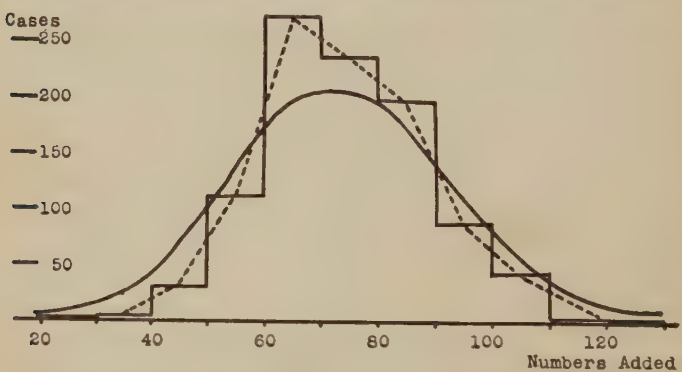

FIG. 12.—THE DISTRIBUTION OF ABILITY IN ADDING PAIRS OF ONE-PLACE NUMBERS IN HIGH-SCHOOL PUPILS. BASED ON TABLE I.

By studying the table we can get a clear and definite idea of the distribution of the abilities of these pupils in such work. If, however, the same facts are presented in graphic form, they stand out in a way that makes them easier to grasp. They are so presented in Figure 12. In this figure the same facts are represented in three different ways. The rectangular polygon shows in a simple, concrete, and accurate way the number of cases of each frequency. If we wish to make this look somewhat more like

the theoretical distribution curve, we may do so by connecting the midpoints of the horizontal lines at the top of each column. This has been done with a dotted line. It should be recognized that the same facts are shown by both graphs. If we wish to make the graph approximate very closely the theoretical distribution curve, it is generally necessary to *smooth* the original results. The tabu-

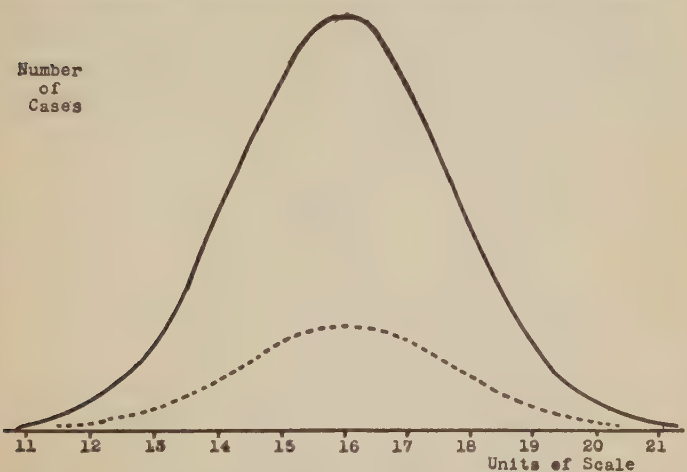

FIG. 13.—A COMPARISON OF TWO DISTRIBUTION CURVES WHEN IN ONE INSTANCE THE NUMBER OF CASES = N AND IN THE SECOND INSTANCE THE NUMBER OF CASES = N/4.

lar frequency distribution is used for this purpose. We start at either end of the distribution and double the end frequency and add the result to the next frequency and divide by 3. To avoid fractions we write down the nearest integer, or whole number. In case of the other frequencies we find the smoothed value by taking the sum of the frequency in question and the frequency just above and just below it and dividing this total by 3. This smoothing process may be repeated several times if desired. In Table I the results

of two smoothings are shown. In Figure 12 the distribution as given by the second smoothing has been shown by a continuous graph in the form of a bell-shaped curve. This is quite like the familiar normal probability distribution. For certain purposes the smoothed curve is to be preferred, but in other cases its use would tend to conceal important variations in the results.

The frequency curve shows essentially three things: the location of the central tendency or average, the variability, and the number of cases. The last item is statistically of importance chiefly as it influences the reliability of the first two. In Figure 13, two graphs are shown. These show

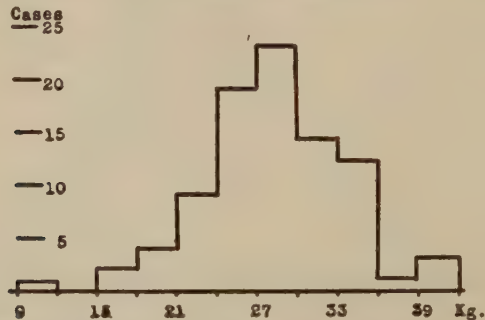

FIG. 14.—THE STRENGTH IN KILOGRAMS OF THE GRIP WITH THE RIGHT HAND OF 88 WOMEN. (Weidensall.)

the same central tendency and the same variability, but the continuous line represents 4 times as many cases as the dotted line. Furthermore, by changing the scale on which these results have been plotted, we might make both curves much flatter or much higher than they are, and still have them representing exactly the same facts. It is, therefore, necessary in comparing different graphs or even in reading a single graph to consider the form of the graph only in relation to the scale on which it is drawn. Otherwise, it has no definite meaning.

Examples of Trait Distributions

As an example of a psycho-physical trait depending largely on muscular strength but also including more purely mental factors we may take strength of grip as measured by the dynamometer. Data for this purpose are supplied by Weidensall's study of criminal women. These are selected on the basis of character rather than on the basis of strength. In the latter respect, then, we are dealing practically with a random selection. The distribution is shown in Figure 14. The number of cases is comparatively

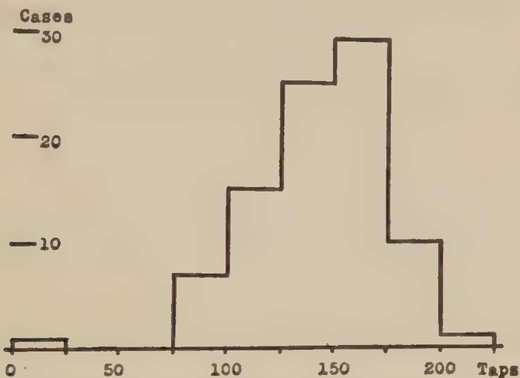

FIG. 15.—THE NUMBER OF TAPS MADE WITH THE LEFT HAND IN 30 SECONDS BY 88 WOMEN. (Weidensall.)

small and the distribution is rather irregular, but if smoothed it would give approximately the normal distribution. The strongest women, it will be seen, are about 4 times as strong as the weakest in the group. If data on a strictly random sample of the general population were available, the range of variation would be greater.

Figure 15 shows the distribution of taps made with the left hand in 30 seconds by the same group of women. Even if we neglect the one very slow case, we find that the speediest individual is about 3 times as fast as the slowest

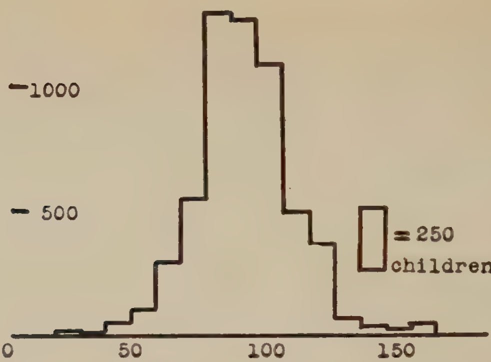

FIG. 16.—THE NUMBER OF SIXTH-GRADE CHILDREN IN NEW YORK CITY COPYING 0-9 DIGITS, 10 TO 19 DIGITS, ETC., IN 60 SECONDS. (Thorndike after Courtis.)

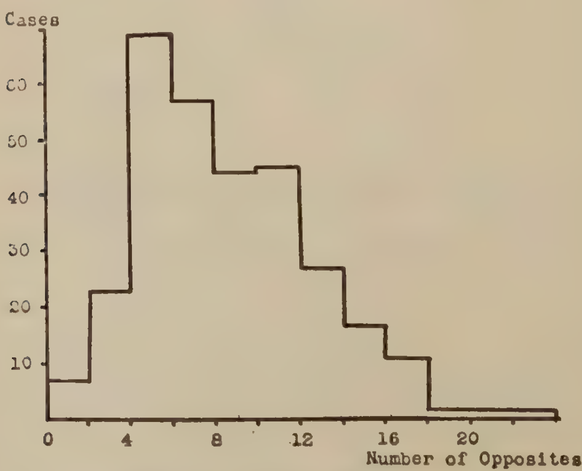

FIG. 17.—THE SCORES OF 305 COLLEGE FRESHMEN ON A HARD OPPOSITES TEST.

one. Here again by taking a sample from the total population we would secure a greater range of variation.

In Figure 16 we have another measure of speed of reaction with a greater degree of mental activity involved. In copying digits we find that sixth-grade children show a very wide variability, though most of them tend to be grouped fairly closely together in speed. The fastest 50 pupils in the group are about 5 times as fast as the slowest 50 pupils.

The examples so far given involve an important physical factor. We shall next examine a few cases where the physical factor is not important. Figure 17 shows the distribution of the scores of 305 college freshmen (men) on the

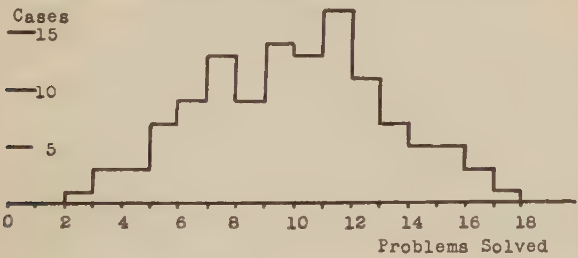

FIG. 18.—THE SCORES OF 121 COLLEGE SENIORS ON THE ARITHMETICAL REASONING TEST IN THE COÖPERATIVE PSYCHOLOGICAL TEST FOR FRESHMEN, 1925 FORM.

The test contains 20 problems and the time allowed is 30 minutes.

Opposite Test devised by Brigham and included in the 1925 form of the coöperative test for college freshmen. Here the physical response required is such that practically every student would have been able to get a perfect score of 27 points on the test if his mental processes had worked with sufficient speed and correctness. The test is, then, essentially a mental one. The results show that some freshmen were 10 times more proficient on the test than were others. However, this does not mean that some freshmen knew the opposites of 10 times as many words as were known by other freshmen. The reason for this is

that the zero of the test is not an absolute zero of ability in giving the opposites of words. If we had a random sample of the general population instead of a selected group of students and we had reliable and comparable measures of their abilities in giving opposites, we would find that the highest scores were more than 10 times as high as the lowest; but in this particular case we must be careful in interpreting the meaning of the zero score on the test.

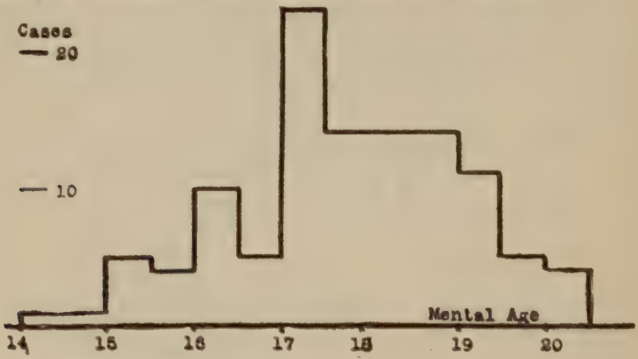

FIG. 19.—THE STANFORD-BINET MENTAL AGES OF 111 COLLEGE STUDENTS.

The scale was extended at the upper limit by allowing additional credit for 85 or more words on the vocabulary test.

As a further example of variations in ability we may take the scores of 121 college seniors on the Arithmetical Reasoning Test included in the 1925 coöperative test referred to above. The arithmetical computation involved in this test is comparatively simple. It is essentially a reasoning test. On this test the best senior in the group is about 8 times as efficient as the poorest one. Here again, however, the zero of the test is not the absolute zero of reasoning ability in arithmetic; but in the general population an absolute measure would show even greater relative differences.

If instead of taking the amount of variation in a comparatively simple function we combine the results of test-

ing a large number of abilities, we get results such as are shown in Figures 19 and 20.

In Figure 19 is shown the distribution of the Stanford-Binet mental ages of 111 students in elementary psychology in the University of Tennessee. The highest scores are not several times higher than the lowest scores, but the general form of the distribution is the same as that found for single

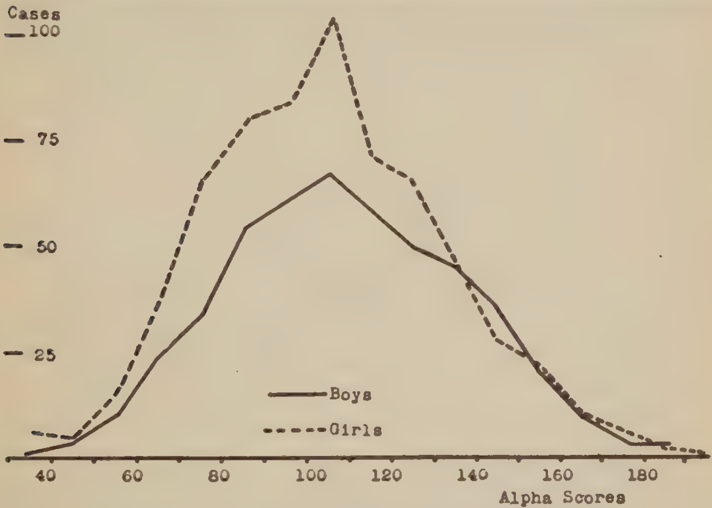

FIG. 20.—THE SCORES OF HIGH-SCHOOL STUDENTS ON ARMY ALPHA: 484 BOYS AND 655 GIRLS.

traits. If we took a sample of the general population we should, of course, have cases running down to practically zero. We could then say that the more intelligent individuals were several times as intelligent as the less intelligent ones.

Figure 20 shows the distribution of the Army Alpha scores of the students in the Knoxville, Tennessee, High School in 1921. Separate distributions are given for boys and girls. On the test the highest scores are several times

as high as the lowest ones, but here again the zero of the scale is not the zero of absolute ability. In general, this result added to the result on the Stanford-Binet serves to show that the extent of variation in the averages or totals of a large number of traits is less than the variation in a single trait.

The outstanding fact about the distributions thus far shown is that they tend to conform to the distribution called for by the normal probability curve A multitude of graphs could be shown of other traits that show the same kind of

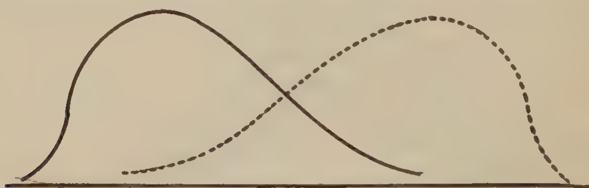

FIG. 21.—SKEW DISTRIBUTIONS.

The solid line shows a distribution skewed to the upper end of the scale while the broken line shows a distribution skewed to the lower end.

variation, but from this it is not to be understood that always and under all circumstances we are to expect that the measurements of a group of individuals will show that the frequencies of different amounts of a trait will conform to the normal probability distribution. It is, in fact, quite common to find what is known as a *skew distribution.* Examples of these are shown in Figure 21.

Causes of Skew Distributions

The causes of skewness in distributions are probably many, but at least three deserve mention here. These are: defective measurements, selection, and the combination of unlike groups into a single frequency distribution.

Defective measurement is a term that may be used to

cover a great variety of sources of error. It must suffice here to indicate the significance of such defect by a single example. Figure 22 shows the distribution of the scores of 115 college freshmen on a reading test. The distribution is very badly skewed to the upper end. No argument is necessary here to show that something is wrong with the measurements. As a matter of fact, the test was an experiment and had not been used before. It proved to be too difficult. This is the reason for the skew distribution.

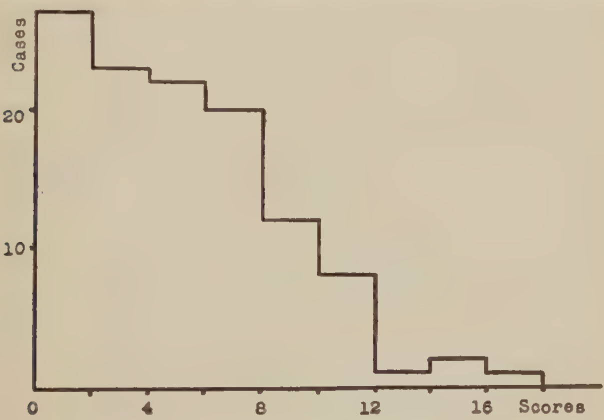

FIG. 22.—THE SCORES OF 115 COLLEGE FRESHMEN ON A READING TEST.

Other measures of reading ability, if tried on the same group, would show approximately a normal distribution, while still other measures which have been standardized for pupils in the elementary schools would show skew distributions, but the skew would be towards the lower end rather than towards the upper end. It is, then, evident that a skew distribution may be due quite as much to the instrument of measurement as to the variation in the group measured.

Selection is at times an important and too often an unsuspected cause of skewness in distributions. If, for example,

we had valid measures of the soundness of the hearts of the population of ages between 20 and 30 years, we should probably find a skew distribution, caused in this case by the death of those individuals born with defective hearts. If we had valid measures of the mathematical ability of graduates from our engineering colleges, we should expect to find a skew distribution. The poorer individuals would have been eliminated by the requirements of engineering studies. Selective factors may prune off either or both ends of an originally normal distribution and so give a result which does not conform to the form usually found for measurements of unselected groups.

Skewness in distributions may be caused by the combination of two or more separate distributions. If, for example, we were to take the heights of a random sample of 100 12-year-old boys and combine them with the heights of a random sample of 200 13-year-old boys and plot a single distribution containing both groups, the result would be a skew curve. The skew would be towards the lower end because of the greater number of older boys. If a skew curve is due to such a cause, the analysis of the data should make it possible to break the distribution up into two or more distributions, and after that is done it is not unlikely that each independent distribution will approximate the normal probability curve.

Bimodal Distributions

If, instead of combining the heights of 12-year- and 13-year-old boys, we had combined the heights of 10-year-old boys and those of men, we should have two practically independent distributions with very little overlapping: one would be almost entirely above the other. This would be an example of a *bimodal distribution.*

There are very few characteristics where a proper analysis will leave a distribution in bimodal form. In the case of

right- and left-handedness, however, there is apparently a real justification for a bimodal distribution. In most of the population the right hand is more efficient than the left, in part of the population the left is more efficient, and in at least a few cases the two hands seem to be about equally efficient. If, then, we measured the relative efficiency of the two hands in a random sample of the general population and plotted the results, we should probably get a result very similar to that shown in Figure 23.

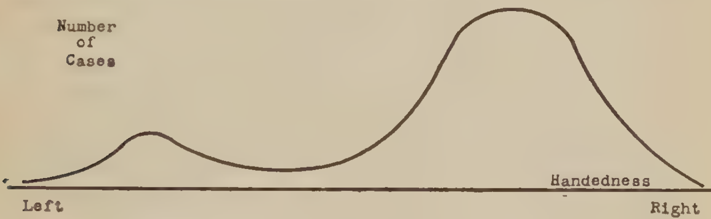

FIG. 23.—ESTIMATED DISTRIBUTION OF RIGHT- AND LEFT-HANDEDNESS IN THE GENERAL POPULATION.

If, instead of taking the relative efficiency of the two hands, we took only one hand and plotted a distribution for a random sample of the general population, it is probable that the distribution of strength and efficiency of either hand would be approximately normal.

Summary

On a logical basis individual differences may be classified as qualitative and quantitative. Qualitative differences of the kind called for by the popular theory of "types" exist in few, if any, mental traits. The only strictly qualitative differences of which we can be sure are those due to loss of capacities possessed by the normal individual. Blindness and deafness are common examples. New combinations may produce the appearance of qualitative differences, as in case of the synæsthesias, but there are really no new

qualities found when these are analyzed. Most individual mental differences can be stated in quantitative terms. When quantitative differences in particular traits are measured in a random sample of a homogeneous population group and these results are plotted in the form of a distribution, it will generally be found that this distribution tends to approach that of the normal probability curve. In cases where this is not found to be true, further analysis will usually show that the failure is due to defective measurement, selective factors, or to the measurements having been based on a heterogeneous group. No claim is made that any carelessly collected assortment of measures will conform to this distribution nor, indeed, that there is any *a priori* necessity that carefully collected measures of a homogeneous group must conform to such a distribution. In general, however, experience shows that if proper methods are used it will be found that variability in most traits conforms rather closely to the normal frequency distribution. The central problems of the psychology of individual differences are, then, to be stated in terms of the central tendencies and measures of variability of different age, sex, race, and other groups.

Problems Requiring Solution

We are now in position to state in a more understandable way the problems with which the remaining part of this volume is concerned. We shall first attack the problem of the cause of variability. Heredity and environment are the two factors which make us what we are. We shall, therefore, study each in turn to see what light they may throw on the causation of differences. Next we shall consider age, sex, and race groups. Our problem here is simply a comparison of the distributions obtained by measuring particular traits in those various groups. Extreme deviations from the norm or central tendency are of sufficient

interest and importance to justify separate treatment. We shall, therefore, study genius, feeble-mindedness, insanity, and delinquency and endeavor to state the meaning of those in quantitative terms. As a final theoretical problem we shall consider the relation between the amounts of different traits in the same individual. The remaining chapters are devoted to the application of these principles to an understanding of educational, business, and other problems.

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CHAPTER VI

THE MECHANISM OF HEREDITY AND VARIATION

Individual differences, whether mental or physical, are due to the combined action of hereditary and environmental factors, and the results of modern biology point to the conclusion that, of the two, heredity is much the more important, if indeed it is justifiable to say that either of two factors is more important when each is both inevitable and necessary.

Early Beliefs on Heredity

Men of all races appear to have had for a long time strong beliefs in inheritance of some kind. They have believed that the characteristics of the fathers were passed on, in part at least, to the sons. Primitive peoples have often believed that the similarity in the characteristics of father and son were due to the fact that the father's soul, or a part of it, had taken up residence in the son's body. Modern men also have had more or less faith in heredity but have been at a loss to give a satisfactory explanation of it. But due to the failure to understand the mechanism of inheritance, modern men have often failed to see its effect and have denied its influence. There are many intelligent people today who rate lightly the importance of hereditary factors and explain differences in human achievement as being due primarily to environmental factors.

Inheritance of Acquired Characteristics.—Observations on heredity occur in literature from ancient times and various attempts at a scientific study of the matter have been made, but the first really scientific contribution that requires mention here is that of Weismann (1834-1914). Before Weis-

mann's time scientists accepted the view held by the general public today to the effect that the characteristics acquired by an individual are transmitted to his children. This view had been advocated by Lamarck in his *Philosophie Zoölogique* in 1809 and was quite generally accepted. Weismann, however, in his monumental work, *The Germ Plasm,* published in 1893 showed that inheritance depended on the germ cells and that there was no known method by which the strength or the skill or the knowledge acquired by an individual could bring about a change in his germ cells so that it would be transmitted. If, for example, an individual studied music and spent much time and money perfecting himself on the piano, he would make certain changes in his nervous and muscular systems, but he would in no way affect his germ cells, and so his offspring would be in no way affected by his acquisition of musical skill.

It is well to recall here the classic experiment on mice. To try out experimentally Lamarck's contention that use strengthened a function and disuse weakened it, if kept up for several generations, a test case was made by cutting off the tails of 21 generations of mice. Then the tails of the 22nd generation were permitted to grow out as usual. According to the Lamarckian view the tails of this last generation should have been shorter as a result of parental disuse. In fact, however, they were no shorter than were the tails of their ancestors on which the experiment began.

In connection with the above experiment we may note that, although certain races or classes have for ages followed certain practices in modifying some part of the body, for example, circumcision among the Jews and foot-binding among the Chinese, no inheritable modification of the structures concerned has resulted. Positive evidence for the inheritance of acquired characteristics is almost entirely lacking, with the result that most biologists do not accept the

theory. As far as man is concerned, we are justified in saying with considerable assurance that acquired characteristics are not inherited. If they were and if all the diseases and mutilations of our ancestors were passed on to us, our lot would be a most unfortunate one.

Prenatal Impressions.—With the passing of the belief in the inheritance of acquired characteristics, a special set of popular beliefs in the effect of prenatal impressions has also passed—at least from scientific consideration—though there remain in popular gossip many weird tales as to magical effects produced on unborn children as a result of the experiences of their mothers. We will cite a typical example. A woman, towards the end of her period of pregnancy, was badly frightened by a cow. The child was born prematurely and was covered with a coat of fine hair. The popular interpretation immediately supplied was to the effect that the maternal fear of the hairy beast had affected the fœtus and caused it to produce a coat of hair like that of the cow. To the student of human embryology the explanation is rather different. Before birth the fœtus normally has a coating of hair. Ordinarily this disappears before birth; but in the present case, partly perhaps as a result of the shock, a premature birth took place and the child appeared with a hairy covering. The point to note, however, is that there is no verified case on record where a woman has been frightened by a bird and her child has been born with feathers or where she has been frightened by a reptile and her child has been born with scales, or of various other combinations that might be suggested. Nor is it likely that such cases will ever be found.

Less fantastic are the stories often told of mothers desiring their children to be musicians or ministers or something else. In order to bring this about they thought intently during the period of pregnancy along the line of the desired vocation with the purpose of affecting the mind of

the unborn child so as to give it a strong tendency in that direction. In such cases it has undoubtedly happened at times that later the child did show a real interest in that kind of activity. To their minds this has proved the efficacy of their method—but not to science. Here, again, we have the fallacy of the neglected aspect. A simpler and more plausible explanation of the facts is available. The desire of the mother that the child be a musician, or otherwise, would in the first instance be based on her own native liking for music. These native characteristics would in some cases undoubtedly be transmitted and would have been transmitted just the same without any maternal concentration or desire along that line. Furthermore, if the mother were so strongly interested in having her child proficient in music, she would in all probability use her influence during his childhood to turn his interests in that direction and would very likely require him to study and practice along that line. The assumption of prenatal influence is, therefore, gratuitous.

Determination of Sex.—Another interesting example sometimes used to support the claims of those with firm faith in prenatal influence is that of sex determination. It may happen that the mother desires the child to be a particular sex, say a boy. During pregnancy she concentrates on the matter and fervently hopes for a boy. Under such conditions she has an excellent chance of being gratified. There are about 105 boys born for each 100 girls. But her chance of being disappointed is nearly as good; and if it is a girl she desires, her chance of being disappointed is greater than her chance of securing her desire. The scientific view as to the nature of sex determination will be presented later in the chapter. Suffice it to say here that there is no evidence to support popular beliefs on the matter.

The only known effects on the fœtus are due to mechanical injuries, toxic conditions, direct bacterial infection, or

disturbances of nutrition. In no case is there the production of specific physical or mental characteristics due to maternal "influence."

Galton's Laws.

Weismann's work cleared the ground of previous misconceptions regarding the working of inheritance, but it supplied nothing definite and authentic to take their place. The next important contribution to the study of heredity was made by Francis Galton (1822-1911). Galton, a cousin of Charles Darwin, was a man of exceptional analytical ability and was much interested in the study of heredity. He collected a large number of family histories with many details as to the characteristics of the different members. From the study of this material he drew two conclusions, known as Galton's laws. These are the *law of filial regression* and the *law of ancestral inheritance.* The law of filial regression is that a child inherits ⅓ of a parental deviation from the average or norm for the population at large. For example, suppose the average height of men to be 68 inches. If a man is 71 inches tall, his deviation is + 3 inches. One-third of this deviation is 1 inch. The man's sons should then be 68 inches + 1 inch, or 69 inches tall. If the father were 65 inches, his deviation would be — 3 inches, and ⅓ of this would be — 1 inch, so that his sons should be 68 inches — 1 inch, or 67 inches tall. The same principle would apply to deviations of the mother's height from the female average. So if both parents were 3 inches above the average their children should average 2 inches above the norm. It should be borne in mind that this result is a statistical average and that it would not apply to individual cases. In a particular family it might not hold at all.

The second Galtonian law, that of ancestral inheritance, is that a child inherits ½ of his characteristics from his

parents, ¼ from his grandparents, ⅛ from his great-grandparents, etc. This also is meant to be taken only as a statistical average and so need not apply in particular cases.

The numerical values used in both of Galton's laws may be subject to revision, but both laws bring out very important principles of inheritance. It is a well-known fact that the children of great men are usually inferior to their fathers, *i.e.*, regression towards the average is generally found in these cases. But whether the children of subnormal parents show a higher average intelligence than is shown by their parents has not been satisfactorily shown. This, of course, must be proved before the law of regression can be accepted in its most general form. If we state the second law in general language, it means simply that the farther removed one is from a particular ancestor, the fewer are the traits supplied by the latter. To this extent the law is, of course, true.

Galton divided inheritance into two kinds: particulate and blending. By *particulate inheritance* is meant the inheritance of a trait as a whole or the separate inheritance of any distinguishable unit or part of a trait. Thus a child might show the brown eye color of one parent and the red hair color of another parent. In *blending inheritance,* on the other hand, the child shows a condition intermediate between that of the two parents. This is illustrated by skin color in Negro and white crosses.

In a later chapter we shall refer again to Galton's work in connection with the study of genius. The study of heredity has made much progress since Galton did his work, but his contributions to the subject should be read by every serious student.

Mendelism

Our present knowledge of heredity is based largely on certain principles originally discovered by an Austrian

monk, Gregor Mendel (1822-1884). We may best arrive at an understanding of his results by considering the methods used in reaching them.

Mendel selected two varieties of sweet peas, a tall variety and a dwarf variety, which he had observed to breed true. He desired to learn whether a hybrid or cross of these plants would show a stage intermediate between them. He accordingly crossed them, and in the resulting generation, known as the first filial generation and symbolized by the abbreviation F_1, he found that all of the plants were tall and that they were as tall as the tall parent. The dwarf characteristic had disappeared. He then inbred the F_1 generation and found that in the next or F_2 generation there were a number of dwarf plants but more of the tall ones. The ratio was approximately 3 tall plants to 1 dwarf plant. The tall plants were as tall as the original tall parent and the dwarf plants were as much dwarfed as the original dwarf parent.

The above results led Mendel to the following conclusions:

1. Tallness and dwarfness are inherited as a unit—they are *unit characters*. They do not split up or mix so that a cross between them will give plants of medium height.

2. Unit characters are of two kinds: dominant and recessive, and when both are present together only the dominant appears.

3. The germ cell is double, not single. The germ cells of the F_1 generation clearly carried factors for producing both tallness and dwarfness although only tallness appeared.

4. The two determiners for a particular characteristic separate and only one is transmitted from each of the parents to each of the offspring, with the result that each of the latter again has double determiners or germs for each characteristic. This is known as the principle of *segregation*.

Further experimentation showed that the dwarf plants

would always breed true and produce only dwarfs. The tall plants turned out to be of two kinds, pure talls and hybrid talls with recessive dwarfness. The pure tall plants if isolated would breed true and the hybrid tall ones would produce talls and dwarfs in the 3 to 1 ratio previously found. The explanation of these results can be best shown by a diagram. We start with a tall plant and a dwarf one, each with double sex or germ cells, and in the tall plant both germs are for tallness and in the dwarf plant both germs are for dwarfness.

Parental		$T\,T$			$d\,d$
F_1	all	$T\,d$			$T\,d$
F_2		$T\,T$	$T\,d$	$T\,d$	$d\,d$

Analysis shows that the double germ cell in each case separates into two parts and one part of it combines with one part from the other plant so as to produce a double germ cell. In this way the number of germs remains constant. By referring to the diagram, we see that 4 combinations of germ cells are possible by taking one germ from each parent plant and combining it with one germ from the other parent plant. Thus we may get:

$$T_1d_1 \quad T_1d_2 \quad T_2d_1 \quad T_2d_2$$

No real difference is indicated by the subscripts 1 and 2 used in connection with T and d. This is only for convenience in analysis. All T's and all d's are considered alike. This gives us then in the F_1 generation all plants with a Td constitution of the germ cells. T is dominant and appears, *i.e.*, determines the plants' height, while d is recessive and has no visible effect. If now we cross the F_1 generation of plants we have:

F_1	T_1d_1		T_2d_2	
F_2	T_1T_2	T_1d_2	T_2d_1	T_2d_2

Again considering all T's and all d's alike we have:

$$1\,TT \quad 2\,Td \quad 1\,dd.$$

The first plants, the TT combination, are pure tall ones; the next ones are tall with recessive dwarfness; and the last ones are pure dwarfs. Here it will be convenient to introduce some new terms. The whole germ, or double germ, is called the *zygote*, and each of the two parts is called a *gamete*. When both gametes in the zygote are alike, it is said to be *homozygous* with respect to that determiner. When the two gametes are different, the term used is *heterozygous*. Davenport uses a different set of terms. Assuming recessiveness to be due to the absence of something while dominance is due to its presence, the plant with the dd or double recessive combination is termed *nulliplex* or no determiner, the tall plants with recessive dwarfness are termed *simplex* or single determiner, while the plants with two determiners for tallness are termed *duplex*.

As examples of Mendelian inheritance in man we may mention eye color, hair color, right- and left-handedness, and polydactylism.

Four types of eye color are found: green, brown, blue-gray, and albino. Green eyes are dominant over brown, brown over blue-gray, and blue-gray over albino. Since blue is recessive to brown, two blue-eyed parents will have no brown-eyed children. Parents with brown eyes may, however, have recessive blue, and in that case some or even all of their children may have blue eyes, though, of course, none may have. As an average the Mendelian ratio of 3 to 1 would apply; ¾ would have brown eyes and ¼ would have blue eyes; but as this is only a statistical average, it would not make it possible to predict the result in individual cases.

In hair color, red is recessive to black and operates in the same way as eye color. If two parents, neither of

whom had red hair, had a child with red hair it would show that both had recessive red. An examination of family traits in such cases would ordinarily, though not necessarily, show red in the relatives of both parents.

Right- and left-handedness appears to involve a number of different things. There is usually a difference in the strength of the two eyes which is likely to be associated with greater skill of the hand on the same side of the body. One may have greater skill in one-handed operations, such as using a saw, with the left hand, while he may have more skill in a two-handed operation, such as using an ax, in the right-handed way. Uni-manual skill and bi-manual skill do not necessarily go together in the sense that one will be right- or left-handed in both. If we consider only the uni-manual phase of the problem, right-handedness is a Mendelian dominant and left-handedness is a Mendelian recessive. Various estimates, ranging from 5 to 15 per cent, have been made as to the number of left-handed individuals in the total population. In right-handed people the right eye is usually better than the left and the long bones of the right side are ordinarily longer than those of the left side. The right and left halves of the face are also usually different to some extent, though the significance of this last fact is uncertain. Jones has shown that if an individual is forced by circumstances—school requirements, accident, or otherwise—to use the natively weaker hand more than the natively stronger one, the individual tends to become ambidextrous in the sense of having two hands of about equal strength and skill; but neither hand reaches as high a level of strength or skill as the natively stronger one would reach if permitted to develop in normal fashion. It has also appeared that when left-handed children in school are forced to write with the right hand, stuttering and stammering result in about 4 per cent of the cases to a serious degree. A natively left-handed individual can, of course,

be taught to write with his right hand; but he cannot be made right-handed in the proper sense of the term—any more than a child with blue eyes can be made brown eyed. An understanding of the hereditary basis of handedness shows, therefore, the absurdity of the frequent attempts to make left-handed children right-handed. If the act requires special skill, as playing the violin, the left-handed individual can never learn to play in right-handed fashion so well as he could if permitted to follow his natural bent. The same applies to shooting, though Army officers have at times required left-handed men to shoot right-handed—thereby saving a few enemy lives. To avoid confusion it should be remembered that a person may be left-handed when using one hand and may be right-handed when using both hands.

Polydactylism is a condition in which an additional finger occurs on each hand. This operates as a Mendelian dominant. It will be used to illustrate the fact that not all dominants are desirable.

Further concrete examples of Mendelian inheritance at this point would take us too far afield. We must return to the development of principles.

The terms *recessive* and *dominant* are often misinterpreted as meaning that the dominant is stronger or more desirable or more likely to be inherited than the recessive. All of these ideas are incorrect. Brown eyes are not to be considered any stronger than blue. It is a question of taste as to which is more desirable. Black skin color is dominant over white skin color but is not generally considered more desirable or a mark of superiority. In the tropics, of course, it serves as a better protection from the sun's rays. Polydactylism, as stated above, is dominant over the normal five-fingered condition. The sixth finger is of no known value and is not a trait the average man would want. Red hair, though recessive, is at times very

beautiful. Since both gametes in the zygote are equally likely to be transmitted, the recessive is as likely to be transmitted as the dominant. If an individual has brown eyes with recessive blue he is just as likely to transmit the blue as the brown. Only from the standpoint of marriage selection would there be any difference in the probability of transmission of dominants and recessives. If a recessive is undesirable, it would, of course, affect a person's chances of marriage if it were homozygous and evident. If it is a recessive in a hybrid and so is not evident, it would not affect the marriage chances of the individual who carried it. From this it may be concluded that a trait, if very objectionable from the point of view of marriage selection, would have a better chance to survive as a recessive than as a dominant. Mental deficiency and insanity may to some extent illustrate this point. It by no means follows that recessives, because they are recessives, are either objectionable or less likely to be transmitted. In the same way, if a trait is particularly favorable from the point of view of marriage selection, it would have a better chance of survival if dominant, because, if it were recessive and not evident, the carrier of it would be less likely to marry young and have a large number of children.

Closely related to the question of dominance and recession is the practical social problem of intermarriage. Many states have laws forbidding the marriage of near relatives. The assumption is sometimes made that all marriage of relatives must be biologically bad. Such is by no means true. If there are no undesirable recessive traits in a family line, no bad results will follow from intermarriage. If, however, recessive feeble-mindedness or insanity is present, it is more likely to appear as a result of intermarriage. Intermarriage may reduce somewhat the variability of offspring; but in good stock this may be desirable, for example, in families of great musical or other desirable ability.

Mendel's work was originally published in an obscure local paper in 1865, and although he called the attention of biologists to his work, it was not considered seriously and dropped into obscurity. At the time the biologists were chiefly concerned with Darwin's *Origin of Species,* which had appeared in 1859. Mendel's work on inheritance was not deemed exactly in line with the problem of evolution and so no biologist would take it up for further study. Mendel died without knowing the tremendous importance of the work he had done. After 35 years the principles worked out by him were again discovered simultaneously by Tschermack, Correns, and De Vries. Fortunately the original paper by Mendel was rediscovered and his name has quite properly been given to the laws.

Since 1900 studies made by many biologists on both plants and animals have indicated that Mendelian principles apply to a considerable extent to the entire biological kingdom, subject, of course, to the modifications which further discoveries inevitably make necessary.

Chromosomes

The most important supplement to Mendelism has been the discovery of the physical basis of heredity. Several biologists, especially McClung, deserve credit for pioneer work in this field; but the most extensive work has been done by T. H. Morgan and his collaborators at Columbia University. The results of these studies have linked the inheritance of characteristics with certain small rodlike bodies in the sex cells. These bodies are known as *chromosomes* and are illustrated in Figure 24. Under ordinary conditions, when stained sex cells are examined under the microscope, a mass of tissue may be seen in the cell nucleus. This is known as *chromatin,* because it readily takes the color of certain dyes. At certain stages of development this mass of chromatin breaks up and appears in the form of

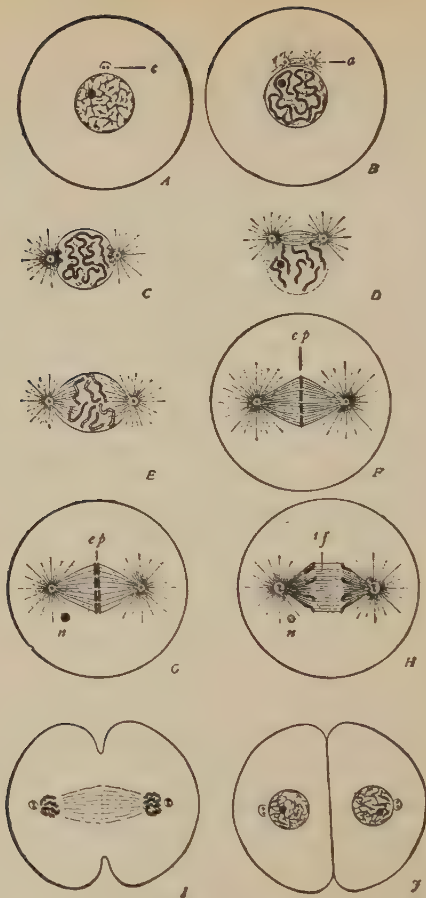

Fig. 24.—Diagrams showing a series of stages in the process of division of the chromosomes during cell division.

(*A*) Resting cell in which the chromatic material lies (apparently) scattered through the nucleus: At *c* is a pair of recently divided central bodies (*centrosomes*) which come to be in the centers of the forces that separate the chromosomes. (*B*) The chromatin has fallen into the form of a thick ribbon or sausage-like body, outside of which lies a dark body which is called the "nucleolus." The centrosomes are moving apart. (*C*) The centrosomes now lie far

the rodlike bodies, the chromosomes. The number of chromosomes is generally constant for a particular species, and in man the number is supposed to be 24 pairs, or 48 chromosomes.

The particular fact about the chromosomes which attracted attention to them as the probable determiners of hereditary traits was the discovery that there was a difference between males and females in one pair of chromosomes. The exact nature of the difference varies in different species of animals. In some cases the male has one less chromosome while in other cases there is simply a difference in size, the male usually having one smaller one. The latter situation appears to be the case in man. The sex chromosomes in females may then be represented by *XX* and those in males by *XY*. The sex of the individual is thus determined by the chance inheritance of the *XX* or the *XY* combination. There is one *X* chromosome in each case; but in the female there is an additional *X* chromosome, while in the male there is a *Y* chromosome instead.

The parent germ cells from which the *spermatozoa* (male)

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apart and the thin membrane around the nucleus is beginning to disappear—a process completed in *D,* where a "spindle" is seen lying between the two centrosomes. The chromosomes are beginning to move under the influence of the new forces centered at the centrosomes. (*E*) A later phase in which changes of two sorts are taking place in the centrosomes; first they are moving to an equatorial position between the two poles, and secondly, they show their double nature by virtue of which the subsequent process of splitting takes place. (*F*) The processes just preceding chromosome division are now completed; the activity of the center is at its height; the chromosomes now constitute an "equatorial plate" (*ep*). (*G*) The chromosomes of the equatorial plate are now beginning to move apart. (*H*) The separation of the chromosomes is continuing and in *I* is completed; meanwhile the activity of the centers has declined and division of the body of the cell is beginning. (*J*) Division of the cell completed; the nuclei and centrosomes at the condition with which we started at *A*. (From Davenport, after E. B. Wilson, *The Cell in Development and Inheritance.*)

and the *ova* (female) are developed contain the full number of chromosomes, *i.e.*, 48. In the process of maturation of the sex cells, however, a *reduction* division takes place and *half* of the chromosomes enter each daughter cell so that each cell now has half the original number but has one chromosome of each pair. All ova or eggs when ready for fertilization contain 24 chromosomes, including one X chromosome. In the male the reduction division results in half of the sperm containing 24 chromosomes, including one X chromosome, while the other half contains 24, including a Y chromosome.

If an egg is fertilized by a sperm containing an X chromosome, the result is a cell with XX sex chromosomes and it will develop into a female; while if the egg is fertilized by a sperm with a Y chromosome, the result will be a male. Sex is, therefore, determined at the time of fertilization and in any particular case it is practically a question of chance as to whether the egg is first reached by a sperm containing an X or a Y sex chromosome. However, as a result of slight modifying factors in man, the numbers of males and females born are not exactly equal, but ordinarily there are about 105 males born for each 100 females. But the fact remains clear that the sex of the individual is determined at the time of fertilization and is due to the presence of an X or Y sex chromosome in the sperm. The inheritance of the specific primary and secondary sex characteristics depends, therefore, on the sex chromosomes.

In line with the inheritance of sex characters it has been discovered that certain characters appear ordinarily in only one sex. In lower animals the presence or absence of horns is often dependent on sex. In man one of the best known examples of sex-limited inheritance is color blindness. This appears in about 3 per cent of the male population but rarely in females. Study of the matter shows that color blindness is transmitted in the X sex chromosome in

the male. As a result it is transmitted from a color-blind man only through his daughters to half of her sons. None of the man's sons is color blind, because he does not transmit the X chromosome to them; and usually none of his daughters is color blind, because although the factor for color blindness is present in the germ cells, it is prevented from development by the presence of a dominant factor for normal vision. When the daughter transmits to her sons the chromosome carrying the factor for color defect, they show the trait because there is no paired dominant factor in the Y chromosome to prevent its development.

While it cannot be stated positively at present, it appears probable that all inherited differences between the sexes are due to this difference in one chromosome. Genetically, therefore, the two sexes are very much alike and the indications are that the female inherits about everything that the male inherits *plus* some additional determiners in the paired X chromosome. Those inclined to hold that man is superior to women would do well to keep this in mind. According to this view the development of the male primary and secondary sex characteristics takes place when only one X chromosome is present, and when two are present the development of male characteristics is inhibited and the female characters develop instead.

Linkage

We have just seen that, in case of the sex chromosomes, determiners for several characteristics are transmitted in one chromosome. Morgan and his associates have shown that in case of the fruit fly, which has four pairs of chromosomes, each chromosome is the carrier of a large number of determiners, or *genes*, which affect the development of different traits. Also it has been shown that these genes are distributed in linear order along the chromosome so that if one end of the chromosome were lost, certain specific de-

ficiencies in development would be found. As a chromosome is ordinarily transmitted as a whole, it is evident that if it is the carrier of 100 or more determiners, all of these determiners will be inherited if one is inherited. In the fruit fly a large number of these determiners have been definitely located in particular parts of the various chromosomes, but in man we know almost nothing of the linked traits aside from a few that are sex linked, and in no other case can anything at all be said as to what is the influence of particular chromosomes on particular characteristics or combinations of characteristics. However, since there is good reason for believing that the mechanism of inheritance is the same in man as in the fruit fly, it seems probable that the same kind of linkage occurs in human inheritance.

The probable working of the mechanism of heredity in man may be conveniently illustrated with cards in the following way: Suppose each chromosome to be represented by a card so that each card is thought of as carrying factors with specific hereditary influences. We may then have a set of white cards numbered from 1 to 24 inclusive to represent the set of chromosomes received by a man from his mother and another set of yellow cards numbered 1 to 24 to represent the chromosomes received from his father. The chromosomes his wife received from her mother may be represented in a similar way by 24 blue cards and the ones received from her father by 24 green ones. These 96 cards represent all the possible determiners that can be transmitted to the children of that couple. The particular combinations that are actually transmitted will be the result of chance, subject, however, to certain limitations. The mother transmits to each of her children one-half of her chromosomes, but one of each pair must be represented in any combination. The same holds true for the father. To illustrate this with the cards: Suppose the white and yellow cards are placed together and thoroughly shuffled or mixed. If we then go

through the pack and take out the first card of each number from 1 to 24 and throw the other cards aside we shall have a complete set from 1 to 24, but it will be a mixture of white and yellow cards. This corresponds to the chance combination of chromosomes in the sperm cell. All of the cards may be placed together again and reshuffled, and again the first of each number may be taken to form a new series. This may be repeated many times and each time the combination of cards will be different. The chance of getting two sets alike by such a process is extremely remote. Add to this the fact that the chromosome combination in the egg with which the sperm combines is determined in the same way, and it will be seen that there is practically an infinite number of chromosome combinations possible from a given set.

Family Relationships

The application of this principle to the question of family relationships is of considerable interest. If, for example, we ask how much are sisters related to each other, *i.e.*, alike, the answer is to be found by seeing what happens in our card problem. If we make two successive arrangements of the cards, how many of the same cards would be in two packs containing half of the cards? In any particular case the result may be anything from total difference to perfect identity. It is theoretically possible for the cards to be entirely different (excepting the card representing one sex chromosome) and it is also possible, though of course very improbable, that all the cards in the two sortings may be alike. The average tendency would be for two successive sortings to be one-half alike. The average relationship between sisters is, then, 50 per cent, or perhaps a little more, though it varies between nearly zero and perfect identity.

It is quite essential that the student of heredity grasp the fact that children of the same parents may have and

at times do have radically different hereditary traits. Without this conception the empirical facts of inheritance are not at all understandable. For example, the writer once heard two men on a street car discussing heredity and one of them expressed his strong disbelief that such a thing as heredity existed, and to prove his point he cited a case of two brothers who were alike in no evident way. If he had understood the mechanism of inheritance he would have known that heredity causes differences quite as much as likenesses.

Another interesting reflection for the student interested in family names and coats of arms and achievements is the fact that the mechanism of heredity forces us to conclude that at times John Doe, who is very proud of his descent from the ancient and honorable Joseph Doe, is in reality no more related to the aforesaid ancient Doe than he is to the present Sultan of Turkey. In the reduction divisions which take place in the maturation of the germ cells it must be remembered that half of the chromosomes are lost, and, since what ones are lost is in any particular case a matter of chance, it must happen that a man is not at all related to some of his supposed ancestors. We have theoretically 64 great-great-great-great-grandparents, but we have only 48 chromosomes, so that it seems reasonably probable that we are not actually related to much more than half of that group of 64 supposed ancestors. Our chromosomes may, of course, be derived from only a few of them. Statistical averages as to the theoretical expectations can, indeed, be worked out for these cases, but the principles of Mendelism show that in individual cases a wide deviation from the average may at times be expected.

Crossing Over

The possibilities of variation as a result of different chromosome combinations are much increased by the

process of crossing over, in which two chromosomes cross each other, adhere at the point of crossing, and then pull apart so that one end of one chromosome is joined with the other end of the other chromosome, so breaking the linkage which normally exists in the factors transmitted in the same chromosome. At present nothing concrete is known as to the way in which crossing over occurs in man.

Interaction of Factors

A very interesting result follows in poultry from crossing a single-comb and a double-comb fowl. In the F_1 generation the combs are neither single nor double. They are of a new and different type. However, this new comb does not breed true but returns to the parent types. This illustrates a mechanism which may be of considerable importance in the production of some mental characteristics in man. The characteristics may be due to the combined effect of the interaction of two paired but not dominant and recessive factors. If so, it will not be transmitted to offspring, because a separation or segregation of factors takes place in the reduction division.

Incomplete Dominance—Blending

In describing Mendel's experiments with sweet peas it is often stated that the homozygous plants and the heterozygous plants look alike, that there is no visible difference. This statement is, however, subject to qualifications. It frequently happens that a hybrid, although showing primarily the characteristics of the dominant, will at the same time show evidence of the presence of the recessive. This appears to be the case in man, where recessive red hair visibly affects the color of dominant black. The effect comes out most clearly in sunlight. When the presence of a recessive is not evident to the naked eye, it is at times easy to detect its presence by using the microscope. Re-

cessives, then, are not necessarily to be considered as having no effect on the organism. They do not always rest quietly in the germ cells and wait to appear in offspring; instead, in many cases, they have a visible modifying effect on the dominant character. It may well be, therefore, that a man who is homozygous with respect to a trait will be appreciably superior to another who is heterozygous with respect to the same thing.

Depressing and Inhibitory Factors

Not all the determiners of hereditary traits act in a positive manner to produce certain traits: some act as depressants or even as inhibitors to prevent the appearance of traits. This is essentially a special case of dominance, without, however, the dominant itself appearing, the action being purely negative. A case of this is found, for example, in cattle, where the determiners for horns may be inhibited from the production of horns. Further examples are reported also in other animals. In man, we have little evidence on the matter; but there is some reason for believing that such factors operate in the production of stature. That this mechanism may operate in the case of many characteristics is not improbable, but to what extent it actually does so we do not know.

Traits Due to Multiple Factors

Gross characteristics, such as height in man, are not necessarily inherited as wholes, as is the case with tallness and dwarfness in sweet peas. As pointed out in discussing the interaction of factors, a characteristic may be the result of the interaction of several factors. Other characteristics may require the combined effect of a number of separate factors in order to appear at all. Still other characteristics may involve the separate inheritance of different elements. There is some reason for believing that human

stature is the result of at least four more or less independent variables: head length, trunk length, leg length, and the activity of the anterior pituitary body. These different things appear to be separately inherited. At times we find people with short legs and a long trunk and at times with long legs and a relatively short trunk. According to this view, the very tall person is the result of the chance inheritance of long head, long trunk, long legs, and a very active pituitary. Another example of multiple-factor inheritances is spottedness in cattle. In order to show spots a cow must have inherited unit factors both for spotting and for color, and the unit factor for spotting can be transmitted separately from that for color.

A case where there appears to be a combination of blending and the effect of multiple factors is found in the skin color of the Negro and white hybrids or mulattoes. Because of the complexity of the trait an almost continuous series of shades from white to black occurs. This serves to explain the cases where the children of two mulattoes show a wide range of variation from nearly white to nearly black. If the maximum number of color factors contained in the parental germ plasm is transmitted to one child and the minimum number to another child, there will quite naturally be a conspicuous difference.

Some have held that the inheritance of skin color is a painful thorn in the side of the Mendelians. Such, however, need not be the case. The tendency today is to think of heredity more and more in terms of the genes or determiners in the germ cells, and there is nothing in the phenomena of multiple inheritance or blending that prevents our thinking in terms of *unit determiners.* If we think in such terms, we will find the principles stated on page 136 above to hold. It is to the credit of Mendel's theory that it has led to a more detailed analysis of inheritance than he originally foresaw. Such is, in general, characteristic of all

scientific progress. The body in growth and development must be regarded as an organic whole, but its heredity must be regarded as a chance combination of discrete elements.

Heredity and Quantitative Variations

We are now prepared to attempt an explanation of the fact pointed out in Chapter V, that, when a large number of unselected examples of a trait are measured and the results plotted, they are generally found to be distributed in a manner closely resembling the normal probability curve or curve of distribution.

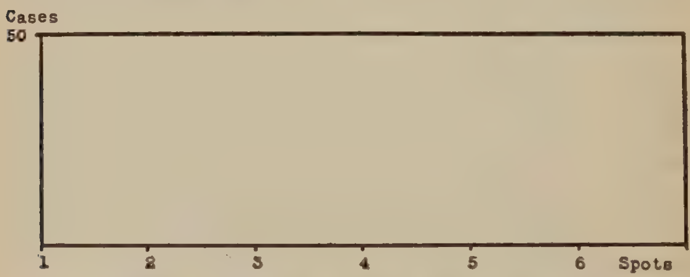

FIG. 25.—DISTRIBUTION TO BE EXPECTED FROM THROWING 1 DIE 300 TIMES.

The correct form of the curve is found by application of the binomial theorem in algebra, but it will be somewhat easier to explain the essential principle involved if we use a somewhat different and more concrete method. Let us, then, engage mentally for a time in the throwing of dice and analyze the results. If a die is rolled on a smooth surface, it will stop with one of the faces up, and if we assume that the die is perfectly made, all faces of the die are equally likely to be up, so that, if we made 300 throws and tabulated the results, we should have each number up for approximately though not exactly 50 times. The distribution secured would tend to approach the theoretical results shown

in Figure 25. Slight variations from this would occur in any actual test, but in as many as 300 throws the theoretical expectation and the actual results would not be greatly different. Suppose now that instead of throwing one die, two are thrown. The possible totals of the two would range from 2 to 12. If a large number of throws were made and the results plotted, what would the graph be like? It could

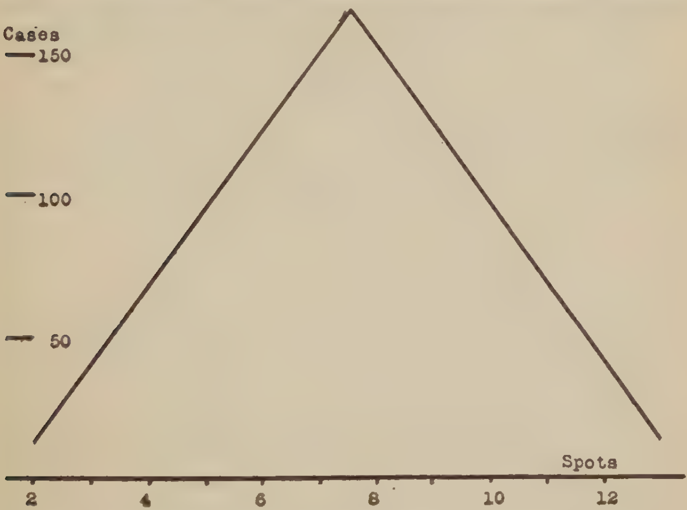

FIG. 26.—DISTRIBUTION TO BE EXPECTED FROM THROWING 2 DICE 1,000 TIMES.

be plotted by applying appropriate formulæ, but for our purposes it will be more satisfactory to examine the case in detail. Consider, then, the total of 2 at one end of the scale of possible totals. What combinations on the two dice could give a total of 2 spots? Clearly the answer is one on each die. We have already noted that one spot will be up on one die in $1/6$ of the cases. In case of two dice, then, the 2 ones would appear together theoretically in $1/6$ of $1/6$ of the cases, or $1/36$ of the total number of throws. Out of

1,000 throws, then, we should find approximately 27.8 twos. The 12 at the other end of the scale would also appear about 27.8 times, since 12 could result only from $6 + 6$. Consider now the 3. Two combinations will give this: $2 + 1$ and $1 + 2$. Each of these combinations will have the same probability of occurring as $1 + 1$, or 27.8 in 1,000. The chances of getting 3 are, therefore, 55.6 out of 1,000. The same holds for 11, since it results from the combinations, $5 + 6$ and $6 + 5$. A 4 may result from 3 combinations:

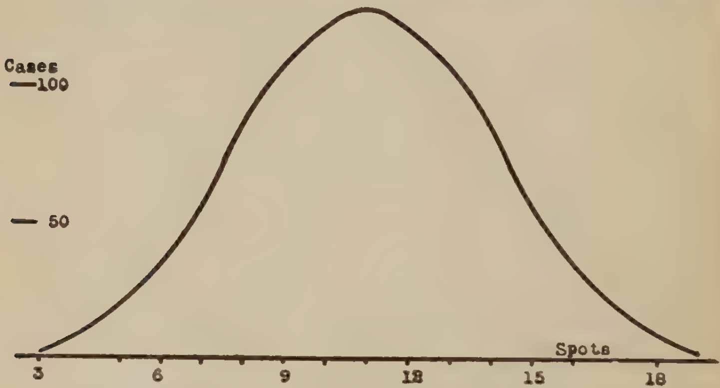

FIG. 27.—DISTRIBUTION TO BE EXPECTED FROM THROWING 3 DICE 1,000 TIMES.

$1 + 3$, $2 + 2$, and $3 + 1$. Similarly a 5 may result from 4 combinations, a 6 from 5 combinations, and a 7 from 6 combinations. The resulting distribution is shown in Figure 26. When two dice are thrown it is evident that a 7 is more likely to result than any other number, because it may be produced by more combinations than any other number. The numbers larger and smaller than 7 occur less frequently because there are fewer combinations to produce them.

If now we were to throw three dice, the range of possible totals would be from 3 to 18. As 18 could result only from

a combination of 3 sixes it would occur in $\frac{1}{6}$ of $\frac{1}{6}$ of $\frac{1}{6}$ of the total number of cases, or one $\frac{1}{216}$ of the cases. By continuing the process and finding the number of possible combinations we may work out the results on which Figure 27 is based. It shows the theoretical distribution to be expected from 1,000 tosses of three dice. It gives us the bell-shaped normal frequency curve. This may be secured algebraically by expanding:

$$(a+b+c+d+e+f)^3$$

The same results secured with dice may be secured by tossing coins. If one coin is tossed and the number of heads and tails is counted, the result from 100 tosses will be approximately 50 heads and 50 tails. This may be expressed by:

$$(x+y)^1$$

If two coins are tossed, the possible combinations will be 2 *H* (heads); 1 *H*, 1 *T*; and 2 *T*. These will be found to occur in a 1 to 2 to 1 ratio. This may again be expressed by:

$$(x+y)^2 = x^2 + 2xy + y^2$$

In a similar way the ratios of the various numbers of heads and tails resulting from tossing a larger number of coins may be found by expanding:

$$(x+y) \text{ or } (H+T)$$

to the corresponding power. Six, for example, would give:

$$(H+T)^6 = H^6 + 6H^5T + 15H^4T^2 + 20H^3T^3 + 15H^2T^4 + 6HT^5 + T^6$$

If we plot the results we again secure the normal probability curve.

Returning now to the real problem in hand, how does it happen that measurements of the stature of 1,000 unselected men will assume when plotted the form of the prob-

ability curve? The evidence at hand indicates that final stature is the result of the combined effect of a number of more or less independent variables. Head length, trunk length, and leg length appear to be separately inherited. The growth of these is more or less independently affected by the action of the anterior pituitary body, by the thyroid body, by nutrition, by exercise, and by disease. Exceptional tallness will, therefore, occur only when, in accord with the laws of chance, an individual has in his chromosomes the factors for great length of head, great length of trunk, great length of legs, great activity of the anterior pituitary, and at least normal activity of the thyroid gland, and when, in addition, the environmental factors of nutrition, exercise, and absence of disease work together. When all these factors—and probably other unknown ones—have been so combined, we find men who have grown to as much as 9 feet and 6 inches. But such combinations and such resulting statures are extremely rare. Men of average or near average stature are much more common, because there are more combinations of variable factors that will produce such a result. The mechanism of heredity would thus apparently require us to expect all complex traits, or traits depending on complex and independently variable causes, to be distributed somewhat according to the probability curve, and conversely, if measures show that the distribution of a trait follows the probability curve, we should suspect it to be due to complex variables. When a trait does not vary in that way, we should interpret it as being due to single or to complex but more or less constant factors. In contrast to stature consider eye color. The eye colors of a population cannot ordinarily be plotted as can stature. Instead, we find two large and distinct groups, blue and brown, with two other small but distinct groups, green and albino. There is no overlapping between these groups, because they are due to certain different and constant factors. If, how-

ever, we measure the different degrees of brownness in an unselected group of brown-eyed people, we shall find something like a normal distribution. This indicates that while brown eyes and blue eyes may involve certain constant differences, within the brown group there are certain independent variables which determine the amount of the color. In short, it would appear that most characteristics involve in all probability the action of a number of factors.

Skew Distributions

As we have seen in Chapter V, not all distributions of mental and physical traits are normal: some are unsymmetrical and are known as skew distributions. Some of these probably result from multiple-factor inheritance where there is dominance with something resembling an additive effect of factors. It might happen in the same way as a result of depressant or inhibitory factors. If, however, these two were equipotent, the distribution would be normal. In Davenport's study of body build, some of the distributions clearly suggest that the skewing is due to dominance. In any case it should be recognized that the effect of dominant —or inhibitory—factors, if unbalanced, is to give skew distributions. The degree of skewness will, of course, depend on the number and strength of the dominant factors in relation to the total number of factors responsible for the quantitative development of the trait. In contrast to this, normal distributions will result from a blending of the effects of factors or from a balancing of dominant and inhibitory factors.

Resemblances and Differences in Twins

The study of twins has contributed an interesting chapter to the question of the relative effects of heredity and environment. Twins are of two kinds, identical or nearly so and dissimilar. In the case of identical twins one egg is

fertilized and starts developing just as if the result were to be a single individual, but during the early stages of growth the fertilized egg or embryo divides into two identical parts and each develops into an individual. The cells in both embryos contain exactly the same chromosome combinations and they develop into identical twins except that in some cases one is right-handed and the other left-handed, due possibly to their having developed out of the corresponding sides of the original embryo. Dissimilar twins are due to the fertilization of two different eggs by two different sperm cells, and, aside from the fact that they happen to grow and develop at the same time, they are as different as any other children in the same family. In this case, naturally, they may be of different sexes or both may be of the same sex.

The physical similarity of identical twins is at times so great that their own mother is unable to distinguish them. This physical likeness also extends at times to the point of suffering from the same diseases at the same time. This peculiar fact has even been reported when the twins were living some distance apart.

Interpretation of Galtonian Regression

Now that we have discussed Mendelism, chromosomes, and multiple factors, we are in position to understand the regression towards the average found in the children of great men. According to the view set forth above, any extreme deviation from the average would be the result of an unusual combination of determiners. Because of segregation and the reduction division, this combination is almost certain to be broken up. Added to this is the fact that the wife of a very great man is almost certain to be inferior to himself—the same would hold, of course, for the husband of a very great woman—and so will contribute to the child an inferior combination of chromosomes. But if

the wife were equal in a general sense, it would still follow in most cases that the new combination of chromosomes would give a weaker combination than the one responsible for the great man. Determiners recessive in the parent might in nearly all cases be expected to have enough effect to produce relative inferiority in the child. On theoretical grounds there is less reason for expecting regression from inferiority towards the mean, but even in that case a certain amount of regression may well occur because of the effect of new combinations of chromosomes involving, among other things, the loss of inhibitory factors. The degree of regression may be different for different traits and may be different above the mean from below the mean: at the present time we do not know.

Importance of Biparental Inheritance

We should not leave the discussion of the mechanism of inheritance without noting the importance of the fact that we have two parents. In the protozoans where reproduction is at times simply a process of cell division without sexual fertilization, the daughter cells are simply smaller parent cells. Genetically they are the same as the parent. If a similar process were found in case of man, the members of each generation would simply be copies of the members of earlier generations. Each person would be, with the exception of age differences, as much like his parental ancestors as one identical twin is like the other. Two parents, however, afford the basis of variation. Children are not like parents, and children of the same parents differ among themselves. A ceaseless variety in individuals is thus provided by making new combinations of old traits. This is the most important foundation of individual differences. It also seems probable that biparental inheritance by facilitating chemical changes in the genes may play a part in causing mutations by which new traits are produced.

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CHAPTER VII

MENTAL INHERITANCE AND VARIATION

What Is Inherited?

Are mental capacities and tendencies inherited? In a rather narrow sense we would be justified in saying that only structures are inherited. We might follow this point of view to its logical conclusion and say that there is, therefore, no such thing as mental inheritance. But it is unnecessary and undesirable to accept such a limited view of the field of inheritance.

Ordinarily structures and functions are to be considered as so closely related that a knowledge of structure will give a knowledge of function. Well developed wings and other related characteristics show that an animal is adapted to flying. Webbed feet generally mark the birds possessing them as swimmers. The strong muscles and sharp teeth and claws of the tiger mark him as a fighter, while the slender build of the deer marks him as a runner. Such external differences in structure, to function efficiently, require, of course, internal neural connections; and we are, therefore, compelled to recognize the importance of fine inner structures as well as the importance of gross external ones. It happens, however, that since we are unable to observe directly nerve structures in the living subject, we are forced to infer the character of these inner nerve structures from our observations of functional activity. It is, therefore, less confusing and more direct to speak of the function as being inherited, though in so doing we may expect it to be understood that the actual inheritance is

structural and that the function is its expression. This is our reason for speaking of "mental" inheritance.

Mental Inheritance in Terms of Structure

It will be well here to consider briefly just what kind of structural differences would account for differences in mental traits. There are two rather different problems: the basis of capacities and the basis of tendencies. We shall consider these in turn.

Inheritance of Capacities.—Sensory capacities depend on the structure of the end organ plus the structure of the connecting nerves. If the end organ is missing or is defective, the sensory capacity is necessarily impaired to a corresponding degree. This will be true even if there is no nerve defect. A defective lens in the eye or a defective middle ear may thus interfere with normal sight or hearing. The inheritance of excellent vision or excellent hearing obviously requires the inheritance of excellent end organs. *A priori*, we should, of course, expect such structures to follow the same laws of inheritance as are followed by other bodily structures.

Sensory capacities also require properly developed connecting nerves and nerve centers. No sensory nerves connect the end organs directly with the cerebral cortex; there is always a synapse in the thalamus. The sensory experience would require the stimulation of the cortical cells in the sensory center. Thus the basis of a "pure" sensation would involve at least three neurone groups. The ascription of meaning to the sensation would involve further neural connections, and it is impossible to say how many neurone groups would be involved.

The capacity for perception requires the combination of several kinds of sensory experiences together with their associated meanings. This requires association pathways and association centers. There are, of course, numerous

definite bundles of association fibers in the cerebrum that must serve for particular kinds of associative connections, and differences in perceptual capacities will involve differences in these association fibers.

Imagery and imagination will depend on the possibility of stimulating the sensory and associative centers by a subjective stimulus to a sufficient extent to produce the same kind of neural activity as that produced by the external stimulus. This activity is characteristically weaker when produced by the internal stimulus, and in some cases it is apparently not possible to secure such activity at all. The difference here is probably in the irritability of the neurones in the nerve centers.

Association is a factor in all mental processes. It depends on the number, degree of development, and physiological state of the neurones of the different specific association centers. Hence, it is obviously possible for one kind of association to be made easily while another one would be difficult, or even impossible.

Memory, as depending on imagery and association, would have the same neural basis as those capacities.

Reasoning is essentially a process of controlled association. Unlike memory, however, it involves the making of *new* associative connections. Differences in the number of terminal arborizations of the dendrites and axones are probably responsible for much of the difference in the capacity for making fruitful inferences. There are very probably differences of a physiological order also, but we do not know what they are.

Learning capacity is simply a result of the various capacities already referred to. It involves the capacity to receive stimuli, to make associations, and to revive these associations later. The neural basis will vary, then, according to the character of the material learned. Similarly, intelligence is only another name for learning capacity and so must

have the same neural basis. The special kinds of intelligence, as mechanical, social, etc., will, of course, involve different neural connections; but we know so little of such differences that it is not wise to attempt a discussion of them here.

Inheritance of Tendencies.—The inheritance of tendencies to action presents the added problem of the basis of already established neural connections. The basis of a simple reflex involves a sensory end organ, a number of connecting neurones, and a gland or muscle. And when the nerve organization is such that more than one response is possible, there must also be some characteristic of particular synapses which makes them more susceptible than others to the passage of a nervous impulse. We may consider it certain that there is such a difference, but we do not know what it is.

Instincts are not satisfactorily described by saying that they are chained reflexes. Instinctive activities are ordinarily complex and are directed by consciousness in such a way that they tend to arrive at some definite end. The prolonged character of the activity and its tendency to recur without any special external stimulus seem to require a somewhat different explanation from that of the reflex. The writer is inclined to accept McDougall's idea of the instinct as consisting of sensory, central, and motor parts with the central part an emotion, which is also the most permanent and least changeable part of the instinct. To this may be added the James-Lange theory of the emotions interpreted in the light of our present knowledge of the activity and importance of the internal secretions in determining emotional reactions. On this basis an external stimulus would set up a series of reflex bodily changes, including the discharge of hormones. The connections between the stimulus and the bodily reflexes would in some cases be native; in others it would be a conditioned response.

In either case the central part would represent a series of native connections. The consciousness of this complex set of bodily changes would constitute the emotion and with it would go the impulse to a particular kind of activity, which again would in some cases be natively determined and in others would be conditioned. In a prolonged activity or in one which was checked or inhibited by conditions, the activity of the hormone would account, in part, for the persistent effort. In the higher animals memory would also be a factor. On this basis the inheritance of instincts and emotions would depend on the inheritance of glands as well as on the inheritance of the nervous system. From histology and comparative neurology we are justified in holding that the thalamus is the primary center for regulating the instinctive and emotional reactions. In conditioned reactions the cerebral cortex would also be involved.

Much criticism has, of course, been heaped upon the James-Lange theory. It must be admitted that our knowledge of the detailed changes in bodily activities which accompany the emotions is very limited. In spite of this it must be said that advances in our knowledge have tended to support the theory rather than otherwise. Certainly there can be no doubt that some, at least, of the instincts and emotions depend on the glands of internal secretion and hence on their inheritance.

Criteria of Inheritance

By what standard shall we determine whether or not a trait is inherited? The problem is difficult and complex because, on the one hand, children may show parental traits as a result of imitation and, on the other hand, in view of the mechanism of inheritance, it is clearly not necessary for a trait to appear in the parents in order to be inherited by the children. When there are qualitative differences, as in eye color, or when there are gross quan-

titative differences that are inherited as units, as in the case of tallness and dwarfness in Mendel's peas, it is very easy to trace inheritance. But as we have pointed out in Chapter V, there are probably few really qualitative mental differences between individuals, and we have no way of knowing as yet to what extent the quantitative variations in mental traits may be inherited as units. The inheritance of mental traits is, therefore, more difficult to determine than the inheritance of many physical traits. But the problem is by no means insoluble.

Before considering a trait hereditary we should determine whether the evidence indicates that it can be produced by any known environmental influence. If it is due to such influences, then, obviously, we have no grounds for considering it hereditary. We know that the ability to read depends on special instruction and activity. We would not, therefore, consider reading as an inherited ability. In certain instances we are able to explain the loss of mental ability by the effects of a disease such as meningitis. In that case we do not consider the resulting level of mental ability as inherited. The influences of the environment constitute a special problem which will be discussed in the next chapter.

A very important criterion of the inheritance of a trait is the extent to which it may be modified by environment. Eye color cannot be changed by ordinary environmental agencies. It is hereditary. So if we find a mental trait which appears in the ordinary course of events but is not produced or greatly improved by training, we may assume it to be hereditary. If we find it also in the parents or in their relatives, that will, of course, strengthen our case.

The fact that a trait may be modified by experience does not in itself prevent the original aspect from being considered hereditary. It only makes the problem more diffi-

cult. There are three methods by which we may determine original individual differences in case of traits that may be greatly influenced by training and experience: We may study the trait before it has been influenced by training; we may compare different individuals after uniform amounts of training; or we may give the best and most extensive training until the different individuals have reached the limit of improvement. The first method is very difficult and requires the detailed study of infants and young children. In studying some traits it is impossible. The second method is the one most commonly followed. The third method is more laborious, but when it can be applied it can be counted on to give a more certain idea of native individual differences.

In some instances, as in the study of instincts and emotions, a comparison with higher animals may be useful. When it is found that a dog, a monkey, and a man will all without special training react similarly to the same kind of stimuli, as to blows, there is good reason for considering the reaction tendency as being innate and hereditary. Similarly, when psycho-motor capacities are found uniformly in the higher animals below man as well as in man, there is good reason for considering them innate and hereditary.

At times the principle of the normal distribution curve will prove useful in determining whether traits are inherited or not. In the case of "general" mental ability there is some evidence to show that the curve is skewed somewhat: there are more low-grade cases than there should be. We may fairly credit this excess to the action of disease and other detrimental factors.

A fundamental test of the inheritability of mental traits is found in the extent to which traits of parents and children correlate and the extent to which traits of different children of the same parents correlate with each other.

By appropriate comparisons the effect of the environment can be eliminated or held constant and the correlation due to heredity can be determined. In the long run it is usually essential that a trait meet this test satisfactorily before being considered hereditary. After eliminating the effects of the environment, the trait must be found to depend on the organic inheritance from the parents before the case can be regarded as conclusively proven. Due, however, to the fact that genes and determiners are the things actually transmitted and that various mental traits are to be thought of as resulting from these, we must not expect that inherited traits will be, in all cases, strikingly like those of the parents. The mulatto inherits his skin color, but it is like that of neither of his parents.

The mental characteristics of twins supply important material for determining the relative influences of heredity and environment. Ordinarily twins have as nearly as is possible the same environment, so that differences can be ascribed to heredity. In the case of identical twins, on the other hand, it is possible to ascribe differences to the action of environment. In some cases identical twins have been separated and have grown up in different environments. Similarities in such cases are clearly due to inheritance.

Finally, the theory which best fits the facts of individual differences and supplies the best basis for their organization is to be preferred. One must consider here not only human differences but the broader problems of the similarities and differences in the whole biological kingdom. One of the greatest difficulties in the way of the acceptance of the principles of mental inheritance lies in the general ignorance among professional psychologists of the mechanism of inheritance. It is scarcely to be expected that a rational individual will consider a trait hereditary when he has grossly erroneous ideas as to the mechanism by which traits are inherited. Before one can tell what theory best fits the

facts, he must obviously be thoroughly acquainted with both. A superficial knowledge will not suffice.

The Inheritance of Mental Traits

In discussing the mental traits we shall examine in order the various psycho-motor traits as outlined in Chapter III.

Motor Capacities.—Motor capacities are only partly mental and they are only partly inherited, but the limits set by hereditary factors are so important that they must be included here.

That strength depends partly on health, nutrition, and exercise will be readily admitted by all. At the same time it is equally evident that, with health, nutrition, and exercise as reasonably constant factors, there are great differences in strength. Some are naturally stronger than others can make themselves by any amount of training. This is, of course, in part a matter of differences in the size of muscles and bones, but it is also partly a matter of what seems to be native nervous differences.

Tapping may be taken as an excellent indication of speed in motor reactions. According to Whipple, a maximum degree of efficiency is reached apparently in about 20 days when two experiments have been performed daily. Individual differences exist both before and after prolonged practice. They must, therefore, be regarded as due to other causes.

Individual differences in motor traits are well shown by comparing the performances of people in playing games such as golf and tennis. Rifle and pistol shooting also show differences, but in a more limited field. The striking thing about all of these is the fact that some people with a very little practice excel others who have had a great deal of practice. There is no rational basis for attempting to explain such differences on the basis of environmental influences.

The particular phase of motor strength and skill which has been most studied is handedness. Most of the population is right-handed, a few are left-handed, and some apparently are ambidextrous. The evidence that this difference is innate and hereditary is fairly conclusive. The differences between the two hands remain from early childhood until old age and are not eliminated by practice unless the inferior hand is exercised much more than the superior one. In such a case the difference may be partly overcome. Ordinarily the differences between the two hands are not greatly affected by age or exercise. Such facts in themselves indicate the probably hereditary nature of handedness, but the matter has been checked up by a study of family histories. The results of several investigators tend to show that left-handedness is a Mendelian recessive character.[1] It is probable, however, that the problem is more complex than has been generally supposed and that there may be the separate inheritance of skill with one hand, skill with two hands, skill with one foot, better development of one eye, better development of one ear, and possibly other differences. Further investigation is necessary to determine the details, but we are practically certain of the inheritance of skill with one hand, whatever may be the final interpretation of the other traits.

Sensory Capacities.—That sensory capacities are in the main innate will scarcely be disputed. Difference of opinion will, however, arise as to the cause of the differences in sensory capacity. Evidence of the inheritance of sensory capacities is of two kinds: direct studies of heredity, and studies showing that sensory capacities are not greatly improved by training.

Studies of the inheritance of sensory capacities have, as we should expect, been confined mostly to the inheritance

[1] *Cf.* R. R. Gates, *Heredity and Eugenics* (New York, Macmillan. 1923), pp. 71 *ff*.

of defects. Vision has been more fully investigated than the other senses. Color blindness in which red and green are confused has been recognized as an inherited trait for a century and a half. It is now known to be a Mendelian sex-linked recessive. Night blindness and myopia (near-sightedness) are found to be inherited, though the evidence is not so consistent as is that for color blindness. Cases are also given of families with a tendency to become blind at a certain age, though this is relatively uncommon.

Deafness may be either congenital or acquired. Some of the congenital cases are not hereditary but are due to intra-uterine injuries. There remains, however, a considerable number of cases which may be considered as definitely inherited. Some studies indicate that such deafness is a simple Mendelian recessive due to one factor; other studies indicate that it is due to two factors. It is possible that there is more than one kind of hereditary deafness.

Normal auditory capacities have been studied in their relation to the inheritance of musical ability by Miss Stanton (1922). The sense of pitch, of intensity, and of time may be said from her results to be inherited on a quantitative basis. There is evidence that segregation takes place, but the exact mechanism cannot be stated.

Nothing of importance in the way of direct studies of inheritance of the other sensory capacities is available.

Evidence favoring the theory of the inheritance of sensory capacities may also be had from a consideration of the effects of sensory training. Pitch discrimination shows little improvement as a result of training, and in talented children, according to Seashore, the limit of development is practically reached by the age of five years. The discrimination of lifted weights shows little or no improvement as a result of practice, though there is improvement with age. Two-point discrimination ordinarily decreases with

advancing age, but, if special practice is given, there may be a marked improvemnt in discriminative ability. This, however, is soon lost unless the practice is continued. Ordinarily, then, we are justified in saying that the accuracy of two-point discrimination is determined by inheritance and age rather than by training.

While it should be recognized that we have only begun the study of the inheritance of sensory capacities, such evidence as we have points to the conclusion that, although special practice will in some cases produce a temporary improvement, the general level of sensory capacity is primarily determined by innate tendencies. Part of the improvement found to result from exercise depends on general mental adjustment to the conditions of the exercise and part depends on the inclusion of higher mental functions.

Affective Capacities.—In a rather general sense it will scarcely be questioned that affective capacities and tendencies are innate and hereditary. Sweet is quite generally felt as pleasant, while bitter is generally felt as unpleasant. The extreme colors of the spectrum, the extreme pitches, and the extreme temperatures are all considered unpleasant, while those near the middle range of sensitivity are considered pleasant. These uniformities would appear to have a physical basis in that those near the limit of sensitivity may well be associated with greater nerve strain.

As a result of experience we come to feel some things as pleasant and others as unpleasant. There are acquired individual differences here we can be sure, but just how far there are innate differences in this respect remains uncertain.

Reflexes.—The innate and hereditary character of reflexes is generally recognized. From a study of such experimental results as those of the simple reaction and of tapping, we are justified in inferring that there are innate

and hereditary differences in the speed of reflexes and that there are probably also innate differences in the intensity of stimuli necessary to evoke particular reflexes.

Reflexes may be conditioned or modified by experience by a process of substituting new stimuli for old ones, new responses for old ones, or by the combination of old reactions in new ways. There are thus both native and acquired differences in reflexes. We may, of course, choose to call all modified reflexes habits, in which case all differences in reflexes would have to be considered innate. Differences in habits are, of course, acquired. Further progress in behavioristic psychology should supply more detailed data on individual differences in reflexes.

Instincts and Emotions.—With the advent of the biological viewpoint in psychology it was natural that much should be made of instincts and emotions. It is, however, difficult to use exact experiments in the study of instincts and emotions, and this unfortunate fact left the field open, to an undue extent, to the speculatively minded writers. Furthermore, the instincts and emotions appealed especially to theorists in the fields of religion, education, sociology, economics, and politics. As a group these writers have known little technical biology and technical psychology and not infrequently have probably cared less. It was only natural, then, that instincts should have been invented freely to suit the needs and caprices of the individual writer. Whenever anything was found in human nature that seemed a bit difficult to explain, there was danger that it would receive the lazy explanation that it was instinctive. Instincts were assumed with the same facility shown by a juggler in taking eggs from a hat. Associated with this prolific creation of instincts was a disposition to ignore the facts of learning and to hold that because the trait was innate it was not subject to modification. Man was supposed to have been created in a particular way and no

amount of environmental influence or experience could change him.

The situation was becoming rather involved when Pawlow made an experimental demonstration of the fact that even the salivary reflex in the dog could be changed. Viewing the matter broadly, this amounts to nothing more than a discovery of the possibility of a particular kind of learning. If a dog could learn, then why not man? Eventually the idea dawned that man also could learn, and with this amazing discovery there came the natural reaction from the extreme acceptance of all kinds of instincts. In characteristic manner this swept to the other extreme, and it is now the fashion among certain writers to question the existence of instincts in man at all and, in certain cases, to substitute conditioned reflexes instead. The inheritance of instincts is thus a lively academic problem.

In the long run the writer believes that the recent reaction will prove to have been beneficial in that it will force a more critical attitude. At the same time he considers the instincts and emotions a most important part of man's inherited equipment.

For our present purposes we may consider the instinct and the emotion as simply two aspects of the same thing. The first question then is: Is this instinct-emotion unit inherited? The second question is: Are there inherited differences in these units?

The average individual with a biological point of view will find it difficult to take the first question seriously. The answer seems so obviously to be in the affirmative. To answer it otherwise would seem to deny the process of evolution. This, frankly, is the writer's attitude. The human individual does not have to be taught to become angry and strike, or kick, or bite. Children do such things frequently to the humiliation of their parents. Such behavior is of the same general kind as that of other

animals below man. Similarly, under certain conditions children show fear and run just as lower animals do. In one instance a boy of two was in a yard with several adults when a dog came running up. The boy had had no previous experience with dogs and had never been told that they would hurt him. He had seen dogs but had never been so close to one. The result was a violent outburst of crying and a rush to one of his parents. Such behavior may, of course, be observed in lower animals. In a similar way young children show curiosity and pry into things entirely without instruction and often contrary to the desires of their parents. Such behavior can be duplicated to a large extent among the monkeys and apes.

During and after adolescence, characteristic emotions and reaction tendencies of a sex character appear. It might, of course, be said that these are learned. Yet it will hardly be denied that sex attraction appears without instruction and contrary often to the wishes of parents and teachers. Even if it be said that children have had opportunities to learn much about sex from their environment regardless of special instruction, such a fact could never account for the tremendous driving power of the sex tendency. The anti-instinct psychologists are entirely unable to solve this phase of the problem. There are admittedly many problems yet to be solved on the question of instincts and emotions, but to attempt to solve them by denying their existence is quite as unscientific as it is to assume a host of mythical instincts. A fair comparison of human and animal behavior shows a marked similarity in those reactions usually classified as instincts and emotions. Under such conditions the inference that the behavior is inherited by animals below man and learned by man is an unnecessary multiplication of assumptions and is contrary, furthermore, to the principles of organic evolution. At the same time we must recognize that in man, because of greater learning capacity,

there is a much greater modification of innate tendencies than is found in lower animals, with the result that few human adult reactions are pure instincts. However, the tendency to a native reaction is often quite strong even in adults and at times breaks through the inhibitions imposed by training. The fact that a native reaction tendency may be modified or inhibited should not lead us to the fallacious assumption that it never existed. The few experiments on infants and very young children on which the anti-instinct psychologists place such emphasis no more prove their contention than would the observation that male human babies of five weeks have no mustache prove that the mustache is not a native male characteristic. We cannot successfully determine the innate tendencies of butterflies by studying the behavior of their larvæ. Yet this is the kind of procedure solemnly undertaken by certain investigators in the study of mankind.

The second question as to individual differences in instincts and emotions must be answered largely on the basis of general observations and general principles plus a few special studies. It is fairly common to find the members of a family with characteristic tempers which appear in several generations. Sex tendencies, curiosity, fear, and self-assertiveness also show characteristic variations within the same family and differences between different families. In view of the known relation of some of these characteristics to organic conditions, it appears necessary to conclude that there are inherited differences in instincts and emotions just as there are inherited differences in bodily structures. But we are still lacking, of course, the precise measurements which are necessary for a final statement of the extent of such differences and the method of their inheritance.

Imagery.—Accurate studies of imagery require observers trained in introspection. For this reason, in part, we have

only limited evidence as to the inheritance of imagery, and this is mostly indirect. Musical families with an "ear for music" are, of course, well known, and they serve to show that a particular kind of auditory imagery and memory is inherited. Miss Stanton's study included tests on memory for tones and the results tended to show that such ability is inherited.

Galton reports a case in which a man was able to multiply mentally one 15-place number by another 15-place number, visual imagery being used. This trait appeared in three generations but with decreasing strength. This suggests inheritance through multiple factors.

The synæsthesias represent a peculiar kind of imagery combination that seems to be innate. The association of numbers with geometrical forms involves an acquired factor in that the particular form used depends on experience, but the fact that such forms are characteristic of families and that they persist throughout the lifetime of each individual would seem to show that the trait is inherited. In the case of colored hearing, in which sounds are associated with colors, there is less reason to suppose that the environment is an important factor. Even here, however, we find differences in the sound-color associations which suggest an environmental influence. Galton has also submitted some evidence to show that this is an inherited trait.

Memory.—Davenport submits a limited amount of evidence to show that memory is inherited and the writer interprets this evidence to mean that memory is due to multiple factors. Galton also describes cases of remarkable memory which run in families.

Immediate memory span cannot be greatly improved by training and this, added to the fact that it shows a rather regular increase with age, indicates that it is innate and hereditary. The general retentiveness of the nervous

system has, since James, been held to be an innate characteristic.

Reasoning.—Evidence that reasoning power is inherited is of two kinds. First, attempts to improve reasoning power, as in the teaching of arithmetic, have not proved successful. More success in reasoning has been secured by more thorough learning of the fundamental number combinations, but no appreciable increase in power has been found. The student lacking in reasoning ability may put forth a great amount of effort and still remain hopeless. Secondly, reasoning power is one of the most important factors involved in "general intelligence" and general intelligence has been shown to be inherited. The evidence for this will be discussed later, but it is clear that intelligence cannot be inherited without reasoning ability also being inherited.

Individual differences in reasoning ability are greater than in most other mental capacities. The failure of these differences to be lessened by training is sufficient proof of their innate character, and the way they run in families shows that they are hereditary.

The Inheritance of Special Abilities

Within the next generation we may expect to have a considerable number of precise studies of the inheritance of special abilities. These will go far to give us a better understanding of inheritance. Already, however, we have some evidence to show that such traits are inherited.

Under ordinary school conditions spelling ability is little influenced by spelling instruction. The older methods of attempting to teach spelling were practically worthless. Under those conditions some children became excellent spellers and others remained very poor. It is not, then, surprising that Earle should have found the same degree of correlation between the spelling abilities of brothers and

sisters as is found between their physical traits. This shows the hereditary character of spelling ability.

Miss Cobb tested parents and children with the Courtis arithmetic tests and found that the children tended to inherit the abilities of one parent rather than an average of the two. This is one of the few evidences we have of segregation of specialized abilities.

Miss Stanton's study of musical ability has already been referred to. While it cannot be said to show just how musical ability is inherited, it does show with considerable certainty that such ability is inherited. This is also reinforced by the history of musical families.

Both Davenport and Galton have submitted evidence to show that a considerable variety of rather specialized abilities is inherited. Here may be included such diverse things as mechanical ability, artistic ability, capacity for military leadership—the Lee family is a notable case—judicial ability, and even morality. On the latter point Galton says: "It cannot be doubted from these facts that religious gifts are, on the whole, hereditary; but there are curious exceptions to the rule . . . namely, the cases in which the sons of religious parents turned out badly."[2] And again he says: ". . . The distribution of natural gifts is necessarily as true of morals as of intellect or of muscle."[3] Galton's exceptional cases are, of course, easy to account for in terms of Mendelian inheritance.

Studies of the inheritance of specialized abilities are of more value than the studies of the inheritance of general ability. However, evidence of considerable value in support of mental inheritance has been secured by the study of mental deficiency and genius. This evidence will be discussed in later chapters. Suffice it to say here that both traits have been shown to be inherited.

[2] F. Galton, *Hereditary Genius* (London, Macmillan, 1892), p. 263.
[3] *Ibid.*, p. 271.

Abnormal as well as normal mental traits may be inherited. This will be discussed in the chapter on insanity.

Multiple Factors in Mental Inheritance

Some of the defects, such as color blindness and deafness, may be due to one or two factors and may be inherited as unit characters in typical Mendelian fashion. In case of most mental traits, however, it appears probable that the observed differences depend on multiple factors. The trait would nearly always be present to some degree, but its strength would depend on the character of the combination of genes determining it. Exceptional strength would depend on an exceptional combination of genes making for strength, while exceptional weakness would depend on an unusual combination of genes of the opposite kind. In most cases the combination of genes would make for something approaching average strength in the trait. Much further study will be necessary, however, to clear up this problem.

Correlation of Traits in Parents and Children

Important evidence for the inheritance of mental traits is afforded by comparing parents and children and by comparing the children of the same parents.

When traits of the kind discussed in this chapter are measured in parents and in children and the results are correlated, the correlations usually range from about .30 to about .55. The more exact the measurements, the nearer the correlation tends to approach .50.[4]

Measurements of mental traits of children of the same parents also tend to approximate .50 when the work has been carefully done and when the results are statistically satisfactory.

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[4] For numerous correlated measurements, see Ethel Elderton and K. Pearson, *The Relative Strength of Nature and Nurture* (2d ed., Chicago, University of Chicago Press, 1915), pp. 40 *ff.*

If we assume a correlation of .50 to be representative of both the above cases, what does it signify? To answer this it is helpful to consider the case in a general way. If we think of the chromosomes (or of the genes) as a number of independent variables we may analyze the genetic relationship between father and son or parent and child very simply as follows:

Let C represent the common genetic elements in parent and child

Let A represent the different genetic elements in parent and
Let B represent the different genetic elements in child

Then:

$C + A$ represents the genetic make up of the parent and
$C + B$ represents the genetic make up of the child

In the nature of the case, A and B are equal. The quantitative relation of C to A and B is uncertain. In this case it depends especially on the degree of similarity between the two parents. Just what is the average correlation between the mental traits of parents we do not know, but the evidence indicates that it is a low and generally positive correlation. If the genes received from one parent are 10 per cent like those of the second parent, this would give a relative value of 55 to C and 45 to A and B. Theoretically in this case the maximum correlation to be expected between $C + A$ and $C + B$ would be .55.[5] This maximum correlation may, however, be reduced by errors in measurement and by limited selection of cases, so that the actual correlation found will generally be less than the true correlation. After making allowances, then, for the unknown degree of similarity between parents and for errors in measurement, we find that the observed correlations between parents and children are closely in line with theoretical expectations.

[5] *Cf.* T. L. Kelley, *Statistical Method*, pp. 189 *ff.*, or H. E. Garrett, *Statistics in Psychology, etc.*, pp. 291 *ff*.

It should be particularly noted here that the correlation of .50 does not mean that heredity is only 50 per cent effective. In the assumed case with perfectly satisfactory measurements a correlation of .55 would indicate that heredity is 100 per cent effective. The fact that it approaches this figure under favorable conditions is strong warrant for holding that heredity is the really significant factor in determining mental ability.

The analysis made above for the relation between parent and child applies also in case of the relation between children of the same parents, except in the case of identical twins, which will be discussed presently. While children of the same parents might show degrees of similarity varying from zero to identity, the average similarity would be slightly above 50 per cent.

It is important to note here that, if these correlations were determined essentially by environmental influences rather than by inheritance, it would be reasonable to suppose that there would be a considerably lower correlation between parents and child than between children of the same parents; but this is not the case. It would also be reasonable to suppose that the correlations between children of the same parents would increase with the age of the children, but this also is not found. The evidence from these correlations is, then, strongly in favor of the inheritance of differences in mental traits.

Identical Twins and Mental Heredity

While ordinary twins do not differ in any important way from other children of the same parents, identical twins are in a class by themselves. It is practically certain that they develop from one fertilized egg which separates into two identical halves at some time during the process of growth. This being the case we should expect their native traits to be the same. They thus afford a most valuable and inter-

esting opportunity for studying the effects of mental heredity.

In most cases, of course, it naturally happens that the environmental influences as well as the hereditary influences are much the same for identical twins, and this makes it more difficult to draw conclusions. In one case, however, we have a careful study by Muller (1925) of a pair of identical twins who were separated when 2 weeks old and did not see each other until they were 18 years old, and who were together but little after that date. One of these had only 4 years of school training, while the other went through high school and had some summer college work. In spite of these and other differences in experience and training, both made practically the same scores on Army Alpha and on the Otis Intelligence Test. On Alpha the scores were 156 and 153. When we recall that the average soldier made a score of only 62 on this test, it is evident that the twins showed an unusual degree of ability on the test. Yet one twin had less than average school training while the other had twice the average school training. A better illustration of the importance of heredity in determining mental capacity could hardly be found.

Other studies on identical twins have repeatedly pointed out their close similarity in all kinds of mental traits. Most of these comparisons have been made by ordinary observation, however, and are less important than cases involving accurate measurements.

While intellectual capacity seems pretty clearly determined by heredity, the studies of twins have not been so favorable or so conclusive on the question of emotional traits. At the present time, however, no conclusion can be drawn in this field, because no valid and reliable tests are available for the measurement of the emotions. The general opinion of those who have studied identical twins is that they have remarkably similar tastes, dispositions, and

characters; but in the absence of satisfactory measurements it is wisest to suspend judgment on that particular problem.

Heredity and Environment

The purpose of this chapter has been to show the importance of heredity in determining differences in mental traits. Further evidence on this point will be submitted in the later chapters on genius, mental deficiency, and insanity. In emphasizing the importance of heredity, however, we must not overlook the fact that certain environmental conditions are absolutely necessary if these hereditary potentialities are to be attained. The action of environmental agencies will be discussed in the next chapter.

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CHAPTER VIII

THE EFFECT OF ENVIRONMENT ON INDIVIDUAL DIFFERENCES

The Heredity-Environment Conflict

There are today two widely different views as to the nature of the respective influences of heredity and environment: one school holds that nearly all important mental differences within a species are due to the effects of environment; the opposing school appears to consider environment as of little importance. According to this second group human mental development is not unlike the running of a clock: once it is wound up and started it follows a prescribed course until its energy is expended and then it stops. Under such conditions changes in environment would ordinarily be of no importance.

The writer's view of the matter is intermediate between these views but with a strong leaning to the hereditarian view under most practical conditions. That possible bias may be kept in mind by the reader.

Environmental Influences

In undertaking to study the influence of the environment we should endeavor to keep clearly in mind the distinction between *possible* influences of the environment and *actual* influences. The first question is of considerable interest but is largely a theoretical problem the solution of which must be left to the experimental biologists. We shall consider briefly what is known as to possible influences of the environment, but the reader should avoid the tendency to

conclude that, because they are possible, they are actual. The really important question in the study of the influence of the environment is not what might possibly be the effect of environmental forces but what is the actual effect under the conditions in which men really live.

A second point of great importance in considering the relative effects of heredity and environment is that of the comparative influences of each on the production of *similarities* as well as of *differences*. *A priori* there is no good reason for expecting that heredity and environment will both be equally potent in both directions, and while our special problem is the explanation of differences, it is well worth our while to keep in mind the possible explanation of likenesses.

Just as heredity causes different people to have different innate traits, it is entirely possible that different environments may have different actual effects. Thus, some environmental conditions may tend to a relatively great extent to produce likenesses in a population, while other environmental conditions may tend to an equal degree to produce differences. Furthermore, the effect of environment is conditioned by the character of the individuals it acts on. Precisely the same objective environment may thus have very different effects on unlike individuals.

Physical and Mental Environment

The effect of environment may be considered under two general headings: the effects of physical factors on the nervous system and so on mental capacities and tendencies, and the effect on mental traits of those aspects of the environment to which we make mental reactions. These two aspects of the environment, the physical and the mental, are closely related at times, but it will be more convenient to consider them separately.

EFFECT OF PHYSICAL CONDITIONS IN THE ENVIRONMENT ON THE NERVOUS SYSTEM

In plants we are familiar with the fact that the seed will not develop into the plant unless there are certain conditions of heat, light, moisture, food, and freedom from injury from mechanical, toxic, and bacterial agencies. We might leave a bushel of corn in a perfectly dark place at a freezing temperature for an indefinite time and not a single grain of corn would grow into a stalk of corn. Furthermore, every farmer knows that even when the corn is planted, the final result depends to a considerable extent on the fertility of the soil, the state of the weather (heat, light, and moisture), and the amount of cultivation. In a somewhat similar way man is definitely dependent on the environment and the infant cannot grow into the man unless certain conditions are present; and certain important variations in environmental factors result in marked variations in the development of the individual. For convenience it will be desirable to consider first the action of physical agencies before birth and then consider the period of growth from birth to maturity.

Physical Factors Acting before Birth

Age of Parents.—The belief that older parents will have stronger and brighter children than young parents has been commonly held. It has been championed in recent years especially by Redfield. In particular he has insisted that genius would not be found where the parents for a number of generations were young. Attempts to check up on this question have brought out two facts: that complete records are practically impossible to secure for anybody's ancestors for very many generations back, and that genius, or at least exceptional ability, appeared from very young parents as well as from old ones.

The results of investigation do not support Redfield's claims.

Pearson has devoted considerable attention to the effects of order of birth, which necessarily is related to age of parents. In one study Pearson has attempted to show that the first-born child is more likely to be a defective than is a child born later. This conclusion is based on certain statistical inferences which have been questioned by other students. The relation of order of birth to deficiency is not, therefore, entirely certain.

In contrast to the foregoing views are the results found by H. Ellis, Cattell, and Terman. Ellis in studying British genius found a greater number of first-born than of later-born children. Cattell found the same for American men of science, and Terman found the same for superior children. In general it should be said, this difference has stood out more clearly in families of from two to five than in larger families. Needless to say, this evidence is directly opposed to the hypothesis advanced by Redfield.

Holmes (1921) has reviewed in some detail the evidence relating to order of birth and on the basis of his study the following conclusions seem justified: (1) Stillbirths increase relatively with increase in the age of the mother from 15 years upwards; (2) infant mortality during the first year is lowest for mothers of about 20 years; and (3) the average length of life of later-born children is less than that of earlier-born children. The fact that infant mortality is higher for mothers under 20 than for mothers of 20 to 25 is, in the present writer's opinion, very probably due to differences in the social and economic level of the mothers in question rather than to the immaturity of the mother. In a study made on royal families Holmes and Wilson found that after eliminating all children who died before the age of 21 years there was no significant difference in length of life as related to age of the mother. However, we should

recognize that results based on royal families do not necessarily apply to families on a lower social and economic level.

While the evidence is rather conflicting, the results seem to favor young parents rather than those of middle or later age. The difference is, though, in any case, a rather small one. Fundamentally it seems probable that the effects of age of parents could be reduced to differences in nutrition and to differences in toxins resulting from drugs, diseases, or senescence. The younger and more active parents would be superior in this respect to the older ones.

Nutrition.—It is evident without special discussion that any disturbance of nutrition which cuts down the supply of food elements below certain minima must necessarily affect the fœtus. To the foods as such must be added those factors which influence the assimilation of foods, *i.e.*, the vitamines, the enzymes, and outside conditions, such as the ultra-violet rays in sunlight. General living conditions, fatigue, worry, poor food supply, and other conditions may contribute to a disturbance of the balance of the endocrine secretions and so may in exceptional cases cause a child of normal heredity to be born an imbecile. To date, however, these problems have not been studied to any great extent and any conclusions must be cautiously accepted.

Injury.—If nutritional and other general environmental agencies of the normal sort are as they should be, there is still the possibility that development may be influenced by injury. Injury may be due to three kinds of causes: bacterial, toxic, and mechanical. It is, of course, possible that the fœtus might be injured in a mechanical way. A very hard fall or a blow to the mother might cause a direct mechanical injury. This involves nothing essentially different from what happens to children after birth. Cases of such injury before birth are, of course, very rare. In case of the first child born to relatively old mothers there may

be injury at birth; but, even if this is sufficient to deform the skull, it does not ordinarily affect the mental capacity of the child, because the brain at birth is so undeveloped that it can stand a great deal of rough treatment. If mechanical injury came before birth it would be still less likely to affect mental development.

Direct bacterial infection of the fœtus is more likely than mechanical injury. Mothers suffering from lues, for example, are likely to have the fœtus infected, and in such cases death of the fœtus and an early miscarriage are the usual result. Children are frequently born dead from such causes, but such infections are far less serious as a problem of population than it is usually considered, because nearly all congenitally infected infants die within the first year after birth and only a negligible group live to be 6 years old, or old enough to enter school. The popular tendency to ascribe mental deficiency to such causes is not, therefore, well founded.

The effect of such an attack on the fœtus, if it survived, would ordinarily not be injury to specific mental functions but would be a lowering of the energy of growth with a resultant general deficiency in mentality. But such cases are very rare.

Toxic effects on the fœtus are often claimed and in exceptional cases are really found. Opponents of the use of alcohol and tobacco often claim that the use of these by parents will shorten the lives of offspring and in particular it would appear that the use of alcohol by the mother during gestation might have some effects. That it does so under any ordinary circumstances has not been demonstrated.

Stockard's experiments on the effects of alcohol on guinea pigs are well known. He showed that extreme doses of alcohol taken by the parents would affect the offspring. The doses used, however, were far greater in proportion than

would be used by any human mother. Under such conditions no conclusion can be drawn as to the effects of even heavy drinking by women during pregnancy. The principle involved here may be illustrated by a simple example. Suppose a physician gives a patient x grains of strychnine and gets an improvement which we shall call y. Who believes that the administration of 100 x grains of strychnine would give results equal to 100 y? Mathematical laws do not apply here, and it is consequently fallacious to assume that when 100 x units of alcohol are administered with 100 y results, the administration of x units of alcohol will give y results. In exceptional cases toxins may be found to affect the fœtus, but under no ordinary circumstances will this be true.

Physical Factors Affecting Postnatal Growth

In general the growth of the child after birth is conditioned by the same factors as is the fœtus. Food, drink, air, heat, light, exercise, and freedom from injury are essential.

Nutrition.—To the psychologist interested in individual differences, two aspects of nutrition are of particular importance: vitamines and the internal secretions. There is nothing of much consequence to say about ordinary carbohydrate, fat, and protein metabolism.

Vitamines.—In recent years physiologists have learned that proper nutrition depends not only on the older familiar food elements but also on certain agents contained especially in different kinds of fresh and natural foods but often destroyed or impaired in cooked or canned goods. For this reason city dwellers are more likely to suffer from eating foods without the proper vitamine content. The result is at times a marked disturbance of nutrition. There are possibilities here for marked disturbances in the development of the nervous system, but we do not know to what extent

vitamine deficiencies are a factor in producing differences in the development of the nervous system.

Internal Secretions.—Metabolism in certain directions is controlled by the glands of internal secretions. Calcium metabolism is partly controlled by the parathyroid, and iodine metabolism is controlled by the thyroid. Both of these substances are of very great importance for the normal development of the nervous system.

An inadequate supply of calcium or the inadequate assimilation of calcium results in defective bone growth and also results in hyperexcitability of the muscles. Muscular tremors, tetany, and death are the results of complete parathyroid destruction.

Thyroid deficiency or iodine deficiency results in a stunting of the growth of the nervous system and in extreme cases leads to imbecility.

Sunlight.—In recent years it has been discovered that the growth of the bones in particular is conditioned by the stimulation of the growing animal by sunlight. Speaking more exactly, direct stimulation by the ultra-violet rays in sunlight is necessary for normal growth. These do not come through window glass, so children who are kept too much indoors develop rickets. A general stunting of growth may be the result in such cases, though we are unable to say to what extent this may affect the final growth of the nervous system.

An indirect effect of climate, including heat and sunlight, is possibly seen in the difference in the time of maturing of blonds and brunets. Brunets in general mature earlier than blonds, and this may be associated with a descent from southern and northern peoples respectively. Whether mental growth stops earlier in brunet whites has not been determined. In case of the Negro, who may be considered as the extreme brunet type, we know mental as well as physical growth does stop earlier.

Exercise.—It is quite commonly assumed that exercise in one way or another is essential for the proper maturing of all mental and physical functions. We must distinguish here, however, between the development of native characteristics and the development of acquired characteristics. Native characteristics, including bodily characteristics and mental characteristics, such as instincts and special capacities, do not necessarily require exercise in order to develop, at least to a marked degree. It appears that their growth is conditioned rather by inner factors. The exercising of the body musculature does result in increased growth, because it stimulates metabolism, but there is not a great difference between the boy who takes much exercise and the one who takes little exercise.

Popular opinion holds that the nervous system acquires more gray matter or more fissures as a result of mental activity. The only change of which we have fairly good evidence is an increase in the thickness of the myelin sheath. This appears to mean that the exercise of particular neurones results in an increase in speed of conductivity of the axones so that exercise gives greater quickness in the reactions practiced. This inference from neurology is supported by evidence from the experimental study of learning. When a function is practiced there is a considerable increase in speed as a connection is perfected.

Injury.—The agencies causing injuries during growth may be classified as mechanical, toxic, and bacterial.

Mechanical injuries to the head are very common. Probably more than half of the adult male population have scars on their heads. It is of course possible, furthermore, to suffer an injury of such seriousness that the brain will be seriously and permanently injured. On the other hand, it must be maintained that in point of fact there are very few mechanical injuries to the head that have any effect on mental capacity. Parents of many mental defectives claim

that the deficiency is due to some blow, but there are too many normal and superior children who have received severe blows to permit the admission that much mental deficiency is due to such a cause.

The effect of drugs during growth has not been studied enough for us to be justified in drawing a conclusion. There is strong and probably justified opposition to the use of coffee and tobacco and alcohol by growing children, but we are lacking in data on which to base a generalization. There is, however, little reason to suppose that drugs are of much importance in producing individual differences.

Injuries from bacterial infection are of many kinds and degrees. Diseased tonsils and adenoids have been urged as the cause of much mental inefficiency and deficiency, but the studies made of the matter have not shown any consistent relation between such defects and mental characteristics.

Among the diseases which do cause injuries to the nervous system are lues, meningitis, scarlet fever, and typhoid fever.

Luetic infection, whether congenital or acquired, may result in a direct injury or destruction of nerve cells with varying degrees of mental deficiency as a result. Such cases are, however, very rare during growth.

Meningitis, when it attacks the cerebrum, may result in inflammation of such serious character that a large part of the cortex is destroyed. In such case deficiency is naturally inevitable, the degree of the deficiency being conditioned by the degree of injury to the cortex.

At times scarlet fever appears to produce an effect similar to meningitis in that no further mental development takes place. The result in case of scarlet fever is, however, much less frequent, and many children show no evident mental impairment as a result of an attack.

Typhoid fever at times causes abscesses in the brain, but in such cases death is the usual result so that only occasion-

ally do children recover from typhoid and show mental symptoms.

It is possible that permanent injury may result from measles or other diseases, but these are very rare and, when they do occur, it should be remembered that the nervous system thus injured had less resistance to begin with.

As a general principle the nervous system may be expected to recover from an injury unless there is an actual destruction of nerve cells. Inflammation is to be regarded as a temporary condition which will eventually be terminated either by death or recovery. If recovery takes place there is ordinarily a speeding up of growth and any temporary loss is made up. And in most cases where the injury is sufficiently serious to destroy nerve cells death occurs. On the whole, therefore, it is not possible at present to assign any considerable part of the differences found in the nervous system to the action of such causes.

Possible versus Actual Environmental Influences

Thus far we have been concerned primarily with *possible* influences of the environment. It is now in order to ask to what extent are differences actually caused by these environmental influences. This problem has been most thoroughly and scientifically studied by Karl Pearson and his students. As his conclusions are in essential agreement with those of other scientific investigators, we shall limit ourselves to a statement of his results. Pearson has studied the effects of cleanliness and overcrowding in the home, economic conditions, physical and moral state of parents, parental alcoholism, unhealthy trades of fathers, employment of mother, and condition of children's teeth, glands, and tonsils. These have been correlated with such children's traits as eye disease, myopia, liability to phthisis, weight, stature, and general health, and mental capacity. The mean value of such correlations is found to be +.03. In contrast to this

result the mean correlation of a series of correlations showing the influence of heredity is found to be +.51. The environmental value is equivalent to zero, while the figure for the influence of heredity is in line with theoretical expectations.

The champions of environmental influences may rebel at accepting this conclusion, but such are the available facts and they will not be changed by adverse theories and prejudices. The only way in which a new conclusion can be justified is by collecting in a scientific manner a larger and more representative body of facts which show a contrary result. The critical reader should consult Pearson's papers.

Much of the confusion as to the influence of the environment is due to an implicit view that man is merely plastic clay, unable to influence his own destiny. This ignores both intelligence and innate tendencies to activity. Not even the lower animals behave in such a manner. Even the lowly amœba will migrate from some environments. Man not only migrates *from* one environment and *to* another, but he changes the environment in which he finds himself—changes it to accord more nearly with his own nature. When a man accepts an environment, therefore, it is in some measure an index of his own nature. In general, then, the environment a child is born in reflects also his probable inherited tendencies.

THE EFFECT OF MENTAL STIMULATION ON INDIVIDUAL DIFFERENCES

Thus far we have considered only the forces of the physical environment and their effect on the body and especially as they affected, indirectly or directly, the nervous system. We shall now attack the problem of the effects of the mental environment, if we may be permitted to use such a phrase.

Formal Discipline and Transfer of Training

According to the older view, mental activity along particular lines resulted in a general increase in mental capacities. If the mind was stimulated by the classics and other approved subjects, it was supposed to become more able to deal with agriculture, with business, and other problems not especially related in content to the material studied in the classical courses. Every student of educational psychology is acquainted with the position now held by psychologists on this topic. There is no general improvement of mental capacities but only the forming of specific connections or the learning of specific facts and habits. General power to memorize is not improved nor is general power to reason improved, though in a particular kind of work much increase in the practical efficiency of both memory and reasoning may result from prolonged work in that field.

It is necessary to point out explicitly that very great improvement may take place as a result of drill on special acquired skills. Take, for example, arithmetic. College students have completed the work in arithmetic given in the elementary and high schools. They would ordinarily be thought to have a high degree of proficiency in arithmetic, and it would be assumed that a limited amount of practice would not result in great improvement. Yet Thorndike found that 7 practice periods of about 8 minutes each resulted in an improvement of about 29 per cent in doing addition. Other great increases are reported by other investigators. Drill or practice on acquired functions of specific nature leads to such improvement that the only reasonable conclusion is that in such functions most of us are ordinarily far below the level where practice would place us. Environment may thus produce marked detailed differences in individuals. Great skill in such things is therefore, only to be attained by long practice, and to keep at a

high level continued practice is necessary. The expert violinist must indeed have the necessary native capacity for becoming expert, but without the prolonged practice he will not become or remain so.

In things that are to a greater degree the result of native capacity, there is relatively less improvement with special drill. Take, for example, running. If Thorndike had tried his students on running the hundred-yard dash for the same amount of time, he would not have found the same amount of improvement. Running is essentially a native affair and practice yields less improvement in such cases.

In pointing out the fact that specialized practice results in making individuals different, it should be kept in mind that the cessation of practice results in forgetting, with the result that the individual differences due to training tend to disappear. This fact is often overlooked but is indispensable in any discussion of mental training.

Knowledge

Among the outstanding individual differences due to environment are differences in knowledge. All knowledge is acquired and what particular knowledge is acquired depends on a lot of conditions. In the first place there must, of course, be ability to learn, and this is innate. In the same environment two children of different degrees of native capacity cannot be expected to acquire the same amounts of knowledge. This principle is used in intelligence testing where it is possible to assume reasonably equal opportunities on the part of those tested. In such cases differences in knowledge are indications of differences in intelligence. But conditions are never identical for two different people and they vary widely in many cases. Consider, for example, the difference in opportunity to acquire knowledge presented to a child born in Central Asia today

and the opportunity presented to a child in New York City. To make the example more extreme, suppose the child in Central Asia to have been born five thousand years ago. Both may be thought to have the same degree of intelligence, but their knowledge could not be the same. It would be extremely different. Differences in knowledge are far greater than differences in intelligence.

Habits

Habits are, by definition, acquired. We copy the acts of our associates and hit upon other things for ourselves. A large part of our activities belongs in this group. They depend, of course, on native capacities and tendencies but vary among individuals more than the native traits vary. The same is true of special skills.

Customs

Customs show much uniformity among particular tribes or associated groups, but when we compare different tribes or other groups we find very marked differences in customs. No evidence of this is necessary.

Sentiments

Sentiments are based on elementary emotional dispositions, but the particular form of the sentiment and the objects or ideas to which they are attached are determined in large measure by environment. For example, most people love the country in which they are born. Also, there is a marked uniformity in the sentiments of particular groups. In fact, some sentiments are practically customary. But in any group there will be very great differences in the particular sentiments held by the different members of the group. Love for members of the opposite sex and love between parents and children are examples of this difference in sentiments.

Beliefs

Beliefs often involve sentiments, particularly in case of beliefs associated with religions and political parties. Beliefs also depend on knowledge. And so, as both sentiments and knowledge are conditioned by environment it is evident that beliefs are also conditioned by environment. What we believe depends very largely on the extent and character of our experience. Our ideas of right and wrong are usually accepted rather uncritically from those about us; but they may, nevertheless, be stoutly held to. In other cases, of course, belief is based on more rational considerations, but in any case the environment is a very important determining factor.

Meanings

No phase of the problem of individual differences is of more interest or of more importance than that of meanings. It comprises in a sense the topics already presented but deserves separate treatment. It is also a problem of peculiar difficulty. We shall not attempt a systematic discussion of the topic here, but certain points are necessary for our purposes and so we shall consider briefly some aspects of the development of meaning.

In the infant the things of significance are the sensations received from the body and the things in contact with the body, especially the food in the mouth. With increasing age there is an increase in control of the body and an increase in the development of the senses. Body sensations and bodily urges remain, however, the important things. Nothing means anything except in relation to these. As the child gets older he walks, then runs, and plays, and manipulates things, and watches other people and animals do things. What do things mean then? We get an answer by asking a child what something is, for example, a chair. We are told in such case that a chair is "to sit on."

similarly, a pencil is "to write with," an apple is "to eat," etc., everything being what it can be used for or is to the child. In no case at the earliest stage do we get an analysis of the characteristics of the object.

Following our definitions a step farther we find a tendency to classification: certain characteristics are attached to a group of objects; for example, a soldier is "a man that fights."

As a final stage in definition we find a more complete analysis and classification. The development of further analysis may be illustrated by the automobile. In early experience the outstanding thing about it is that it "runs." It is "to ride in." The mechanism at first means nothing. Spark plugs, fan belts, inner tubes, pistons, etc., are unknown and unthought of. If in time, however, one starts to drive, or even rides long enough with other people, things will happen. A little tack will cause the inner tube to acquire meaning. The wearing loose of a bearing and the resulting knock and loss of power will cause that part of the mechanism to acquire meaning, because such things come to have a definite relation to one's activities and purposes.

As with the automobile, so with other things: the meaning of things is determined by the way they fit into our experience and purposes.

What does alcohol mean? To one man it suggests the satisfaction of strong desire; to another man it suggests a wrecked home. Can we expect both to take the same attitude towards the saloon?

What does evolution mean? To many it means only that man is descended from the monkey. To some it means a contradiction of the Bible and of religion. To the biologist it means a principle of growth and of organization which clarifies and systematizes a mass of data about plants and animals. Under such conditions it is clearly unrea-

sonable to expect that the attitude of the ignorant man and that of the scientist will be the same towards such a subject.

Only where experiences have been standardized and made uniform and where purposes are also to a considerable degree uniform can meanings be the same or very similar to different people.

Of fundamental importance in this connection is the development of instincts and emotions and of acquired interests. We pay attention to those things in which we are interested and it is especially those things that we remember and which consequently give meaning to new experiences.

Ideals and Goals

Most men are striving for some goal. They may not have clearly in mind just what the objective is, but usually they are pretty conscious of the chief things aimed at. In such things as the choice of a profession, the determination of the goal to be pursued has an important determining influence on the entire course of the individual's activities. Just what these goals are will depend in the first place on the native capacities and tendencies of the individual, but specifically they depend on the environment. Today a boy may have a serious ambition to be an aviator, while a generation ago that would have been nothing more than an idle fancy. A few thousand years ago it might have been taken as an indication of disturbed mentality. Old ideals pass and new ones and new opportunities appear with each generation. Women have for ages tended to have as paramount the goal of wifehood and motherhood, but with changing social and industrial conditions many of them are taking up new goals and objectives. And aside from this major objective, there are always minor objectives which have an important influence on the individual's career. Men have had a wider range usually, of objectives

to pick from, and for this reason there have been greater differences between men than between women.

Environment and Similarities in Traits

When we accept the fact that such things as customs and conventions are due to the influence of the environment, we should not forget that these are essentially *uniformities* rather than differences. Custom and convention make people more alike. Becoming educated and socialized is in large measure a process of losing one's individuality. Most learning is imitation: the pupil tries to act and think like the model. It is not, then, surprising that some social psychologists emphasize learning and decry innate tendencies, for learning is the basis of a considerable part of our uniformity in social ideas and behavior. At the same time, if we compare different social groups, we find differences between the groups in customs, habits, religions, etc.; but if these different groups engage in commerce or war or otherwise communicate, they begin to grow more alike rather than unlike.

Because of this tendency for a common environment to make people more alike, it seems safe to say that in a given environment the mental differences between people are due much more to innate than to external factors. Radical differences in environment and experience may indeed make radical differences in the mental content and outlook of individuals, but, in most of the cases where we consider the effects of environment, it is probable that there are more factors to produce similarities than there are to produce differences. For this reason the effect of heredity on human nature is of vastly more importance to the student of individual differences than is the effect of the environment. The study of environmental influences may be left largely to the social and educational psychologists, for it is in those fields that learning is most important.

EVIDENCE OF THE RELATIVE EFFECTS OF HEREDITY AND ENVIRONMENT

Now that we have considered specifically the effects of the environment in determining the characteristics of the individual it seems desirable to consider certain studies which have an important bearing on the general question. This we shall proceed to do. In this we shall be concerned with actual rather than possible effects.

Twins

Some of the most convincing evidences of the relative influences of heredity and environment have resulted from the study of twins. Galton, who seems to have been the first to study the matter scientifically, says there are two classes of twins, the identical and the dissimilar, or those much alike and those little alike. This classification, as we have seen, is based on a real biological distinction between twins but is misleading if taken literally. To be more exact, the two classes of twins are, first, those resulting from the division of one fertilized ovum, these being virtually identical, and second, those resulting from the fertilization of two ova, these showing resemblances varying from zero to identity with a mean resemblance of about 50 per cent.

Thorndike (1905) tested 50 pairs of twins in New York City and calculated the coefficient of correlation for a number of tests. The values of r range from .65 to .85 with a mean value of about .75. This result is open to objection, however, because no distinction was made between the two groups of twins. A further objection may be raised that due to the method of selection the unlike twins would be less likely to be selected. The study is of value in showing the influence of heredity but tells us nothing as to the two distinct groups.

Other studies of twins have been made by various inves-

tigators and some of the most interesting of these have been reported in the *Journal of Heredity*. Some ~~of~~ the reports should be read by the student for greater detail.

Twins almost identical in appearance and separated for much or most of their lives and having very different experiences are found to have a marked similarity in tastes, dispositions, ideas, and intelligence. Such twins reared together also show virtually the same characteristics. But unlike twins show quite as much a range of variation as do brothers and sisters who are not twins. Some twins are very much alike and some are very little alike. It is these latter cases that constitute the best evidence of the limited influence of the environment. Born together and reared together, eating the same food and living in the same house, knowing for the most part the same people, attending the same school, they would nevertheless show marked differences in tastes and ideas. Environment is, in such cases, apparently powerless to change the natures given them by the original chromosome combination. It will, of course, be admitted without question that if identical twins were reared in different countries by natives, say one in China and one in California, they would have different languages, different religions, different customs, different manners, and some differences in prejudices naturally resulting from such differences in environment; but if both were then sent to another country, say Russia, to learn a new language and new customs, it seems evident that they would make about the same progress and would have much in common.

Studies of Progress in School

A second line of evidence bearing on the influence of the environment consists of the studies of the rates of progress made by different children in school. The environment in school is approximately the same for the different children in the same room. At least it is as nearly the same as it is

practically possible to make it. In spite of this uniformity in the school environment, there is the greatest variation in what different children learn. Some learn practically nothing; others learn a great deal. When proficiency in any school subject is measured by a well constructed test, it is found that the abilities of the different members of classes of reasonable size vary approximately according to the normal curve of distribution, and the range of abilities is ordinarily very great. These differences cannot be charged to the school environment; they must be charged either to differences in the effects of environment outside of school or to differences in native capacities and tendencies. Both of these undoubtedly have their influence so that it is a question of which is more important. Numerous studies have shown substantial correlations between capacity as measured by intelligence tests and performance in school work. If native differences in emotional dispositions could be measured so as to determine the relative strengths of curiosity, fear, and any other emotions closely related to work in school, it is reasonable to assume that the total correlation between native traits and results accomplished would be greater. On the environmental side parental influence is important, but the evidence does not show it to be nearly so important as differences in native capacity. Every teacher is acquainted with pupils who fail in spite of effort and in spite of great encouragement on the part of their parents. It is impossible for a pupil to pass a subject fairly without reasonable capacity, but it is possible and often happens that good students are such in spite of very discouraging home influences. So important has the factor of differences in native intelligence been shown to be that we are classifying children on the basis of intelligence scores. On the other hand, we have not found it profitable to measure home and other environmental influences and use those results as a basis of classification. Every known method of instruc-

tion and every plausible environmental influence have been tried on subnormal children in the effort to cause them to get a good understanding of school work, but no set of environmental factors has yet been discovered which will serve as an effective substitute for native capacity. If, however, the capacity is there, it is ordinarily a much simpler matter to supply the environmental stimuli necessary for learning. In the light of recent experimental work with mental tests, all of our busy activity over methods and devices in teaching—however important these may be—seems of slight importance in comparison with the factor of the intelligence of the children taught.

Practice and Individual Differences

A third line of evidence as to the effect of environment is found in the studies of the effects of practice of a function on the degree of individual differences in that function. As we know, the practice of a function improves it. It seems, then, at least possible that a considerable part of the differences observed in individuals may be due to the effects of practice. However, when a given group practices on a function, it is found in general that the best ones to begin with make the greatest improvement and the poorest ones make the least improvement. Practice then increases individual differences. While this shows that some differences are influenced by practice, it also shows that there are important original differences before practice is begun.

Colleges Attended by Great Scientists

A fourth line of evidence on the effect of environment is found in Cattell's study of the colleges attended by great men of science. Cattell (1906) finds that great scientists are quite as likely to have been educated in a small college as in a large college such as Yale or Harvard. It might seem that being educated in a smaller college would be a

handicap, since the environment would theoretically, at least, be inferior from a scientific standpoint. The present writer is not at all convinced that the atmosphere of a large college is more permeated by scholarly ideals than that of the small college, but, be that as it may, the college attended has no particular effect on the result. Teachers are sometimes inclined to take undue credit for the success of their students. The true view would appear to be that in graduate work excellent teachers, or at least scholars, select excellent material to work on and so get better results. It is by no means safe to say that the results are in any unusual degree due to the teacher's own efforts. The chief function of the teacher would appear to be to introduce the student to the material of the course or subject. Ten different teachers of chemistry will present about the same things in a given course and apparently the personality of the teacher and the methods used are of slight moment compared with the native capacities and dispositions of the students.

General Conclusions

The conclusion of all this appears to be that environment, including education, presents a varied lot of stimuli to the individual. From these stimuli each individual selects some and ignores others according to his native tastes and capacities. Environment is unable to produce increases in capacity, but environment does make great differences in the connections made in the nervous system. All knowledge, all skills, all habits, all customs, and all sentiments and ideals reflect the influence of the environment. Perhaps the most conspicuous example of this is found in the socialization of the individual. Each individual gives little to society; from it he receives much. This includes the language, the manners, the ideas, the ideals, the religion, the customs, the conventions, the fashions, and the accumu-

lated folk lore or knowledge of the people among whom the child is reared.

As long as the environmental agencies, including the schools, attempt to produce specific connections in the nervous system, to impart specific knowledge and skills, success will follow in proportion to the degree of intelligence of the pupils and to the time and effort spent; but when the environmental agencies start to improve the mind or increase the intelligence or the reasoning power of children, the result will be failure. Environment molds but it does not create. *Nihil ex nihilo.*

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CHAPTER IX

AGE DIFFERENCES IN MENTAL TRAITS

Growth as the Development of Hereditary Traits

With increasing age during the period of growth the individual shows two kinds of changes: changes due primarily to the growth and development of innate characteristics, and changes due primarily to the effects of environment and experience. In the same way, during the period of involution or senescence there are the separate influences of inheritance on the one hand and of environment and experience on the other. In the present chapter we are concerned primarily with the former, or the innate set of factors; but we shall also pay some attention to the latter, or environmental influences. Actually, of course, both sets of factors cooperate in producing the characteristics of the individual.

Growth and developmental changes in some of the lower animals are more striking than in man. In the insects we have the egg, the larva, the pupa, and finally the adult. In amphibians, such as the frog, we have an intermediate tadpole stage between the egg and the adult. In such cases the adult may be but little like the preceding stages. A consideration of these cases is useful in helping us to understand the importance of inherited tendencies in growth and development. Because of the great similarity of the human infant to the adult, we are in danger of assuming that the infant is only a miniature adult and that the changes that do occur are due mostly to the environment. But such is clearly not the case. In man as in the lower forms cited,

the innate characteristics of the germ plasm are gradually unfolded with advancing age. The full mental and physical development is realized only at the end of the period of adolescence. The development of the beard and the change in the voice of the male are examples of the late maturing of hereditary traits. It will be recognized also that ordinary differences in the environment do not make significant differences in these traits. The same is very largely true of other innate characters. As long as the minimum essentials in the way of food, air, etc., are provided and as long as the organism is protected from serious injury, growth follows the course predetermined by the organization of the germ plasm. Our chief problem here is, then, the determining of the nature and extent of the changes in specific characters during the growth period.

The changes in old age leading to death are less understood, but it seems that even death must be regarded as a natural termination of processes which are inherent in the organism.

Mental and Physical Development

Mental growth cannot be weighed or measured in the same way that physical growth can and we do not know so much about it as we do about physical growth. Since mental growth is commonly thought to be closely related to physical growth and perhaps to follow the same kind of laws, it will be useful to consider the phenomena of physical growth before attempting to study the more difficult questions of mental growth. It must not be assumed, of course, that growth of the body will be accompanied by a parallel and similar change in mind. The physical giant is not necessarily a mental giant. Before birth, body growth goes on at a very rapid rate, but we do not credit the fœtus with having a mind at all. It is only the physical basis of mind that is growing.

PHYSICAL GROWTH

On the physical side there are certain outstanding differences between the infant and the adult. The infant is much smaller and much weaker. Also he is not proportioned as an adult. He has a relatively large head and relatively very short and undeveloped legs. When we follow the growth of the infant to adulthood, we note a very rapid but unsymmetrical growth during the first year of life with a gradual slowing down in the rate until about the tenth year, when another acceleration takes place which again is followed by a slowing down of growth and finally by its termination with the assumption of the adult state. In describing these growth changes we shall in this chapter confine ourselves to a discussion of general growth changes and shall illustrate them by data on the growth of boys only. Sex differences in growth will be discussed in the next chapter.

A detailed discussion of physical growth is not intended here. A very large number of measurements of growth have been made in different countries by numerous investigators and the detailed discussion of these would take too much space and is not necessary for our purposes. The available measurements, furthermore, are open to criticism on a number of grounds. When made on children of diferent ages and the different ages are compared, it is by no means certain that the norms found for a group of 15-year-old children represent what a group of 6-year-olds will become. Elimination from school will cause the higher figures to be based on a somewhat different group of cases from what the earlier figures are based on. This probably has but little effect on the norms for height and weight, but we do not know exactly what the effect is. Statistical studies of growth are open to the further objection that they do not show individual variations in growth. Until re-

cently little attention has been given to questions of variation. The earlier tables simply give the norms or averages of each age group without giving any measure of variability. It must, however, be recognized that great differences in rate of growth and in time of maturity exist. Another difficulty in studying growth is found in the fact that size and function do not necessarily go together, though probably very little error is introduced on this account when dealing with averages.

Growth in Height and Weight

Figure 28 presents the curves of growth in height and weight for boys. A study of the chart shows that growth is not at a uniform rate. During the first 3 years growth is very rapid. During the first year the weight at birth is trebled and thereafter the rate of growth decreases with age. At the age of about 10 years there is a slowing down in the rate of growth which is followed by a period of very rapid growth from about 12 to 17. Growth in height and growth in weight are not at the same rates. Growth in height takes place first and is followed by growth in breadth and in weight.

Detailed studies of growth show that there are seasonal variations in growth and that growth is by parts. Growth in height takes place most rapidly from April to August and is followed by a period of minimal growth from August to November. Weight, on the contrary, increases most rapidly during August and September and least during May, June, and July. Rapid growth in height is followed, as stated above, by growth in weight. The growth processes are, therefore, in no sense symmetrical.

Growth of Internal Organs

The liver is a good indicator of the metabolic condition of the body and is especially important because it stores

up sugar to be used for muscular energy. The growth curve for the liver shown in Figure 29, is very interesting. The rapid growth of the first 3 years slows down and there is relatively little growth from 6 to 9. From 12 to 15, how-

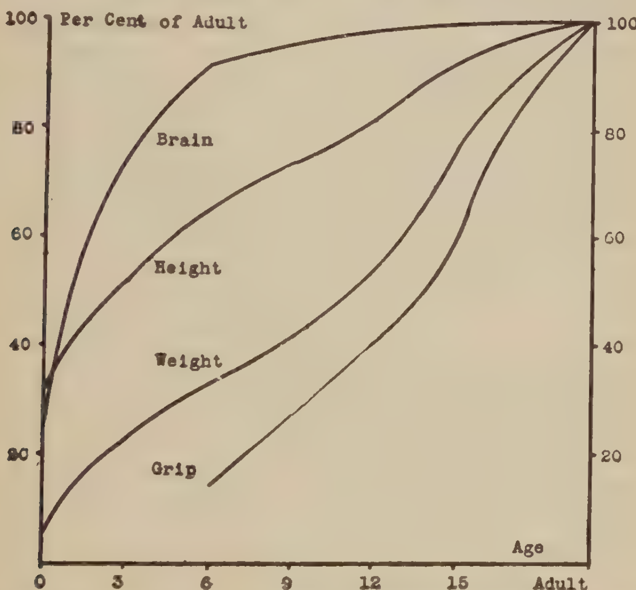

FIG. 28.—GROWTH CURVES FOR THE BRAIN, FOR HEIGHT, FOR WEIGHT, AND FOR STRENGTH OF GRIP.

The ordinates are in per cents of the adult measurement in each case. The values for the upper part of the brain growth curve have been smoothed. (Based on data collected by Tyler from different sources.)

ever, there is a rapid increase in rate which continues to the end of adolescence.

The growth curve for the kidneys (see Fig. 29) shows the usual early rapid rate followed by the pre-adolescent retardation and the adolescent acceleration.

Growth of lung capacity does not fluctuate so much as

does growth of some other organs, but the general form of the curve is the same as usually found.

The heart shows a decreasing rate of growth during the first 6 years, then an increasing rate which slows down on the approach of maturity.

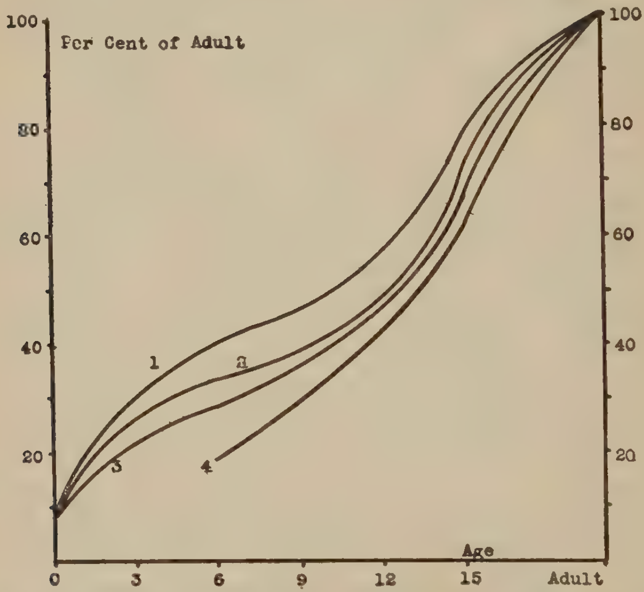

FIG. 29.—GROWTH CURVES OF THE (1) KIDNEY, (2) LIVER, (3) HEART, AND (4) LUNG CAPACITY.

The ordinates are in per cents of the adult measurement in each case. The values for the kidney and for the heart have been smoothed. (Based on data from Tyler.)

Growth of the Brain

The head is at birth relatively the largest part of the body and its rate of growth is also most rapid so that it is the first part of the body to reach its adult size. When the boy enters school his head is nearly as large as a man's, though growth continues slowly apparently through adoles-

cence. The brain differs from the other parts of the body in that the nerve cells apparently must reach their full size before functioning very much or at all, while the other organs function efficiently when the cells are smaller in size and fewer in number. The increase in brain size after the third year is due neither to increase in number nor in size of the nerve cell bodies but to an increase in the fibers and especially in the thickness of the myelin sheath. This latter process appears to continue for a good many years, until the age of 40 or 50 years perhaps in brain workers. The most important growth changes in the brain after 12 years are, in addition to the myelin sheath, in growths of nerve endings and in internal organization, but these make no difference in the external appearance of the brain.

Rates of Growth of Different Organs

A comparison of the different growth curves in Figures 28 and 29 demonstrates clearly that different organs grow at different rates at the same time as well as that the same organ grows at different rates at different times. Uniform growth at a fixed rate is not found.

MENTAL GROWTH

With the development of mental tests it has become possible to measure mental growth as never before. Since mental growth cannot be seen as can physical growth, it was quite natural that even scientific men should differ widely in their conclusions regarding it. And the differences are still with us because our methods of mental measurement are still far inferior to our methods of physical measurement. Two kinds of measurements are available on mental growth: measures of general intelligence and measures of specific mental capacities. We shall discuss the results of the general intelligence tests first.

Age and Intelligence

At the present time there are two distinct varieties of tests when these are considered on the basis of the method of determining age standards: those of the Binet type having the tests arranged by ages, and those of the point-scale type in which the separate items of a test are scored on a point basis and in which age norms are determined by the average number of points made by children of a given age on a test. Both of these types of tests aim to give a quantitative statement of changes in intelligence and both are used as a basis for predicting the future development of the children tested. For this purpose the Binet system has, however, a serious defect. Since the tests are arranged by ages, there is nothing whatever to indicate the absolute difference between different ages. We cannot tell whether the mental growth from 4 to 5 years is absolutely more or less than the mental growth from 14 to 15 years. All we know is that an average child of 4 years is able to do certain exercises and that when he is 5 he will ordinarily be able to do certain other exercises. Likewise, growth from 14 to 15 consists in the improvement in the ability to do certain things; but, when we designate the improvement from 4 to 5 as an increase of 1 year in mental age, we cannot be sure that the year of mental age in that case is the same as the year of mental age in passing from 14 to 15. The Binet method is thus appropriately termed a qualitative method of measuring intelligence rather than a quantitative one. Though the writer appreciates that this statement would be objected to by many Binet testers, it is necessary to maintain that the Binet scale is not properly a quantitative one, because a really quantitative scale presupposes some standard or absolute scale, and that the Binet system does not give. It is thus distinctly limited in its application to quantitative studies of the growth of intelligence.

The attempt to apply the Binet method to quantitative

predictions of growth has made it necessary to make certain *assumptions* regarding the quantitative aspect of mental growth, because the method is not in itself adapted to making such determinations. Thus in order to predict on the basis of the I. Q., Terman in 1916 assumed mental growth at all ages to be quantitatively equal up to 16 years and that it then suddenly stops. He probably would not have stated the matter just that way, but the method of using the I. Q. required such an assumption. On this basis the growth curve becomes a straight line as illustrated in Figure 30. It should be noted, however, that, whenever growth of any kind has been measured by any absolute scale, a straight-line graph has never been found; and from the nature of the case it is very unlikely that such rectilinear growth will ever be discovered.

In practice it is found that the application of Terman's assumption to average children at early ages works fairly well, but that it falls down when applied to inferior or to superior children or to average children at later ages. Doll showed that the I.Q. of defectives does not remain constant but that there is a decreasing rate of growth with advancing age. Others have shown that in the case of superior children there is an increase in I.Q. with advancing age; the greater the deviation of the I.Q. from the normal, the greater the error of prediction. It is not entirely unjust to say that the I.Q. is accurate only where it is not needed, *i.e.*, in case of the average child. Studies of both the inferior and the superior groups show that the assumptions both of constant growth rates and of uniform arrest at 16 years are invalid.

The studies of mental growth by means of re-tests of the same children with the same tests over a period of years are unsatisfactory because of the difficulty mentioned above and because of the further fact that the giving of a test affects its value for future applications. Inferior children usually profit but little from such tests, but superior ones

may profit a great deal. In neither case do we know exactly what the effect of re-testing is.

We shall not further criticize the Binet method at present, but it should be evident that results secured by it are dis-

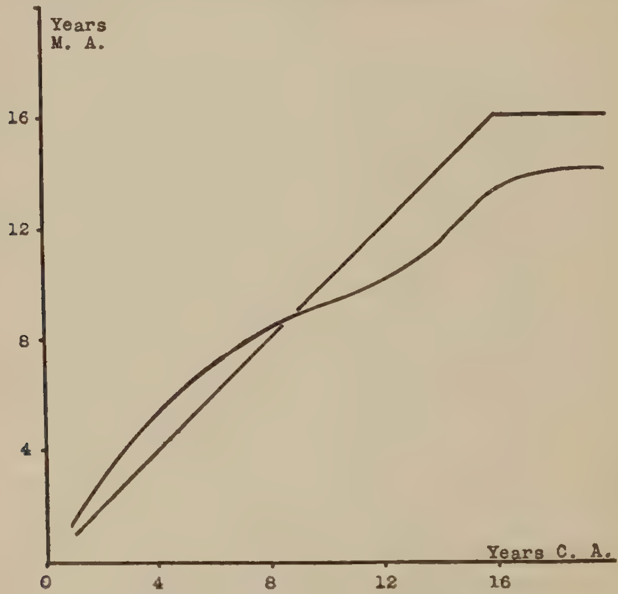

Fig. 30.—Hypothetical growth curves.

The straight line shows the kind of growth assumed in customary calculations of the I.Q. by dividing the mental age (*M.A.*) by the chronological age (*C.A.*). The curvilinear graph is an estimated mental growth curve and is intended to agree more closely with physical growth and with the results of point scales.

tinctly limited in value for the quantitative study of mental growth. For the intensive study of particular cases the Binet method is indeed of great value: it is the conclusions drawn from certain assumptions to which the writer objects.

The point-scale tests whether in the form of individual tests, as the Yerkes point scale, or in the form of a group

test, as the Army Alpha, are to be preferred—indeed something of this kind is a necessity—for studying in any accurate way the growth of intelligence; although re-tests by means of these tests are open to the same objections to which re-tests by means of the Binet tests are subject.

Figure 30 shows the general form of the growth curve secured by the application of point scales to the study of the growth of intelligence. This differs considerably from the theoretical straight line assumed by the Binet testers in calculating intelligence quotients.

The norms given for the various point scales cannot be accepted as entirely accurate comparable measures of the mentalities of children at different ages. There are two reasons for this. We cannot be sure that the value of points is the same throughout the scale. One part of the scale may be relatively more difficult than another. The second reason is that age norms for group tests are usually based only on the children who have reached grades where they can be supposed to be able to read. This eliminates the lowest grades of intelligence. And at the upper end of the scale elimination from school affects all mental-test standards. The children of lower mentality have been eliminated with the result that the norms are based on a superior and, hence, non-representative group. There are no norms available that can be said to represent fairly the average changes in intelligence with age. They represent rather the school population.

Age and Psycho-motor Functions

Thus far we have dealt with the problem of mental growth from the standpoint of the intelligence tests now in general use. The results from them are for general intelligence. It will now be convenient to analyze the problem of mental growth in somewhat greater detail. For that purpose we

shall consider the results of studies of the improvement with age of various psycho-motor functions.

There is considerable difference in the effect of maturity on the sensory capacities. Sensitivity to pain and the fine-

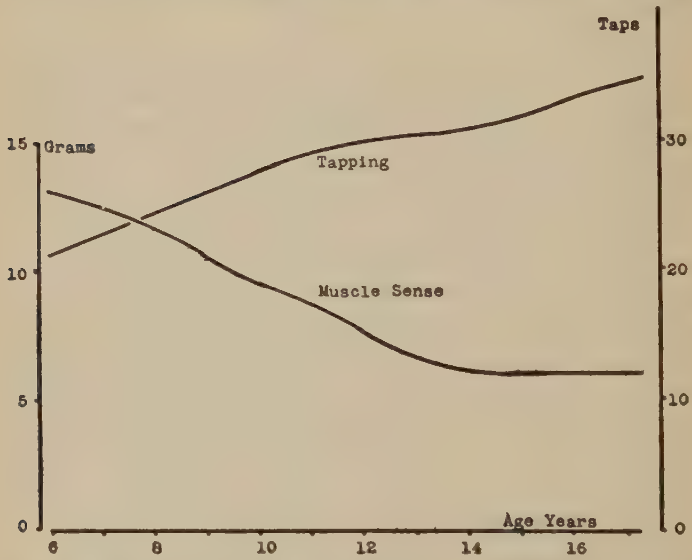

FIG. 31.—GROWTH OF ABILITY IN TAPPING AND IN THE DISCRIMINATION OF WEIGHTS.

The curve for tapping shows the number of taps made by boys of different ages in 5 seconds. The curve for muscle sense shows the amount of error in judging the difference in weights. Both curves have been smoothed. (Based on data from Thorndike after Gilbert.)

ness of two-point discrimination *decrease* with age practically up to the time of full maturity. Pitch discrimination appears to reach its full development at a relatively early age. Some children of 5 years do better in this respect than the average adult. Most of the sensory capacities, however, improve with age. Figure 31 shows the improvement of

muscle sense as involved in the discrimination of lifted weights.

Motor capacities of all kinds improve with age. The improvement in tapping as an example is also shown in Figure 31.

Suggestibility appears to differ from most other psychomotor traits in that it first increases and then decreases. When two equal weights are of different sizes, there is a tendency to overestimate the weight of the smaller one. Taking this as a measure of suggestibility, it is found that suggestibility increases to the age of 9 years and then decreases until maturity.

Interesting results of the study of mental growth are given by Pyle. Tests for substitution, logical memory, rote memory, cancellation, free and controlled association, and invention were given to children of ages from 8 to 18 and norms for each age and for adults were determined. A general mental growth curve based on all of these tests is shown in Figure 32.

The study of the growth of particular capacities leaves no doubt that mental growth, like physical growth, is not symmetrical but is by parts and is variable in rate at different ages. Such studies also seem to show a continued increase in capacity until at least beyond the age of 18 years, but this may well be due to chance selection of cases studied or to transfer of training or both rather than to real mental growth. In any case, the assumption that mental growth stops at 16 years is very probably incorrect. Kuhlmann concludes that even mental defectives grow mentally after 16, though this is contrary to Doll's results.

When group mental tests such as Army Alpha are given to students of different ages and different grades or years of work, an increase in the average score is found at least until the junior or senior year in most colleges. We are not justified, however, in concluding that all of the difference

found between the different ages is due to differences in mental growth. Some of it is due to the elimination of the poorer students from school. The remaining difference is due to growth or to the transfer of training. The writer (1925) has studied this problem among the students of the Knoxville, Tennessee, High School. In April, 1921, all of

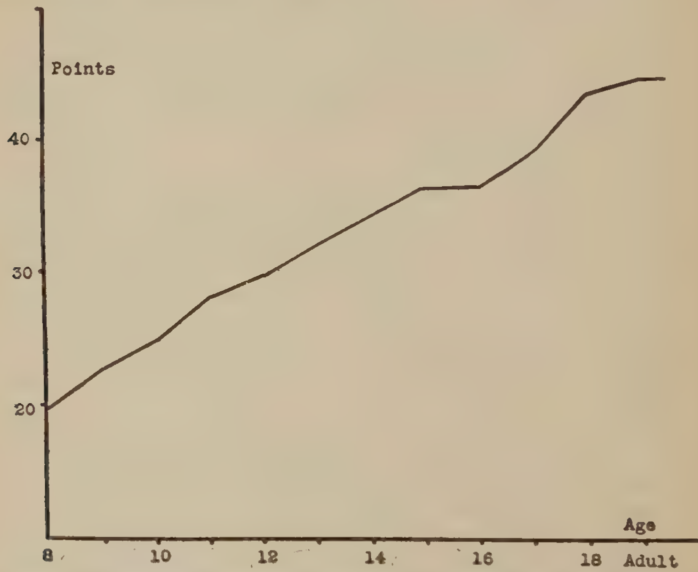

FIG. 32.—THE CURVE OF MENTAL GROWTH AS DETERMINED BY COMBINING THE RESULTS OF 7 TESTS. (After Pyle.)

the students were given the Army Alpha Test. The results were kept until all of the classes had graduated and norms were then determined for the members of the original four classes who remained to graduate. This made it possible to compare the freshman class as a whole with the part of it that graduated in 1924. The median score of those who graduated at that time was 100.8, while the median score of those who did not graduate then was 89.2. While there is

considerable overlapping in the two groups, the average of the graduating group is distinctly above that of the group that did not graduate. This demonstrates the necessity of allowing for elimination in attempting to estimate mental growth by comparing age norms as ordinarily determined. However, in this study, after allowing for elimination, there was evidence of some mental growth after the age of 16 years. The writer (1926) has also compared freshmen and seniors in Syracuse University by means of the Miller and Coöperative tests. This study has shown that, after allowing for elimination, there is improvement in the senior scores as compared with the freshman scores in some of the more linguistic tests though not in the others. The safest interpretation of this result seems to be that the improvement is due to transfer of training rather than to mental growth. If this is the case, it may possibly be that part or all of the apparent mental growth in high-school students after the age of 16 years is also due to transfer of training.

The Mental Age of the Average Adult

There remains the puzzling problem of the final level reached by the average citizen. When it was assumed that mental growth stopped at 16 years and that the average citizen kept on growing until that age, the average mental age was said to be 16 years. We have already seen that due to the nature of the Binet scale the term 16 years of mental age is an uncertain quantity. It cannot be considered either twice the mentality of the average 8-year-old child or 4 times that of the average 4-year-old child. In its assumed form it was supposed to be that but actually was not. Two conclusions that now appear true have overthrown the former idea regarding the mentality of the average citizen. These are the demonstration that mental growth as measured by the tests continues after 16 years and that the tests placed in the 16 year or "average Adult"

level by Terman are too difficult for the average citizen. The most important evidence of the latter statement is from the Army tests. Terman himself admits that his estimate was probably too high, though he declines to accept the result of the Army tests at face value. A second line of evidence is from the tests of college students. The average score made by college students on the Stanford Revision is usually from 17 to 18 years. One group of 60 sophomore psychology students examined by the writer had a median mental age of 17 years and 5 months. For some few the scale was not difficult enough, though for most it was. The median is, therefore, approximately correct. On the basis of calculating the I.Q. of adults by using a chronological age of 16 years, this would give a median I.Q. of 109. According to Terman's estimate nearly 25 per cent of the general population have I.Q.'s of 109 or above. College sophomores, according to this, would not be a very selected group. This is contrary to too much evidence to be seriously considered. If, however, we use 13 years, the Army result, in figuring the I.Q., the I.Q. of the college students becomes 134. This would indicate that the college students are drawn from the best 1 or 2 per cent of the population. This is perhaps a bit extreme, and 14 years would perhaps be better. This would give an I.Q. of 125 for the average of the college group. This is probably about correct. We conclude, then, that in terms of the Binet scale the average citizen probably reaches a mental age of about 14 years, but that he reaches this level at a later chronological age. At what age we cannot say. The writer's guess is about 17 years.

Individual Variations in Mental Growth

In physical growth it is known that there are very great individual variations in rate and time of growth. Some children reach the adult size early and others reach it late.

As a rule, perhaps, the below-average cases mature earliest and the above-average ones latest, but this is by no means without exceptions. How much variation of this kind exists in mental growth we do not know. The tendency is for the lower-grade cases to complete their development earlier and the higher-grade cases later, but it appears possible that very superior mentality may also reach full maturity early. At present we are not in position to answer the question.

The Future of the I.Q.

The I.Q. has been of very great value, but it is now found to be subject to errors of a kind that distinctly limits its usefulness and makes very difficult its calculation in the exceptional cases where it is most needed. To simplify the calculation of the I.Q. and to avoid the errors of the present methods, the writer has for several years used a chart similar to that shown in Figure 33. When this is made on cross-section paper, it is necessary to read from the chart only the final mental age expected. Errors in arithmetic are avoided. Before such a chart can be put in permanent form, however, it will require very extensive experimentation. And this should be done with point-scale methods rather than with the Binet, though the same plan may also be followed with the Binet, but with less satisfactory results.

The growth curves for different capacities are not exactly the same. Sensory capacities mature earlier than associational capacities. There is a difference between different sensory capacities and presumably between different associational capacities in time of maturing. When, therefore, a general intelligence test is made, the exact form of the growth curve found may depend on the elementary functions involved. A general intelligence test is only a group of tests representing various rather specialized capacities. The capacities tested by different intelligence tests are not the

same. This is shown by the fact that the correlation of different tests with particular subjects is not the same. One test gives a better correlation with scientific subjects or with specific scientific subjects and another test correlates better with the languages. It is thus not improbable that growth curves for different tests of general intelligence may be

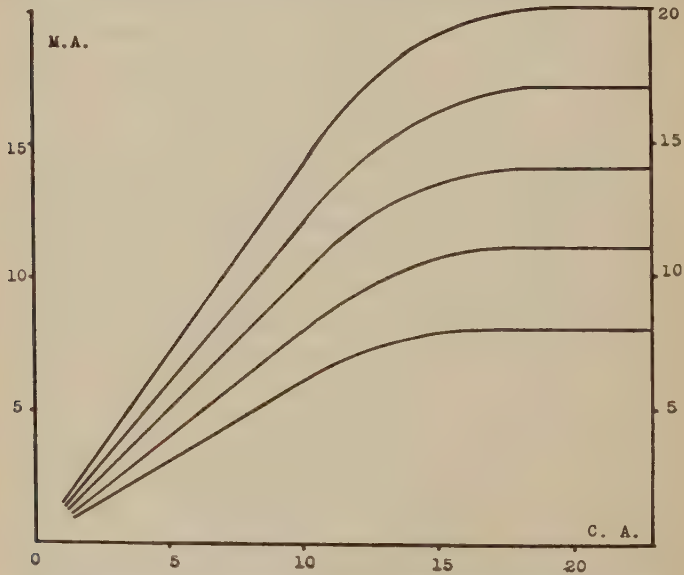

FIG. 33.—SCHEMATIC CHART TO SHOW HOW FINAL ADULT MENTAL AGE COULD BE ESTIMATED WITHOUT USING THE INTELLIGENCE QUOTIENT.

somewhat different. This may be in part the basis of some of the differences in conclusions that have been reached by psychologists on the final level and time of arrest of mental growth.

It should be further noted that the tests of general intelligence are not in reality even attempts at a general survey of intelligence. No attempt is made to test special capacities for music, painting, social adjustment, and mechanical

abilities. Special tests, it is true, have been developed along these lines; but they are not included in the tests called tests of general intelligence, and such a designation should, therefore, be understood to mean tests of general school intelligence, for such they are, being based primarily on adjustment to school requirements with especial emphasis on linguistic abilities.

The chart presented is, therefore, intended to represent school capacities rather than a general average of intelligence. What is needed is a detailed study of growth of special capacities involved in the different kinds of work.

GROWTH OF EMOTIONS AND CHARACTER TRAITS

The discussion of mental growth based on tests and measurements is limited mostly to sensory, motor, and intellectual traits. It does not adequately take into account the development of the emotions and of character. For a discussion of such things we must turn to the more general studies of child development. Much work has been done in this field, but we shall confine ourselves to a summary of some of the conclusions of two writers, Kirkpatrick and McDougall.

Kirkpatrick's Six Periods

Kirkpatrick divides growth into 6 periods as follows:

1. Age 1 year, pre-social period
2. Age 2 to 3 years, period of imitative socialization
3. Age 4 to 6 years, period of individualization
4. Age 7 to 12 years, period of competitive socialization
5. Age 13 to 18 years, period of early adolescence
6. Age 19 to 24 years, period of late adolescence

The development of character and personality depends on the development of interests and sentiments and these in turn depend on the development of the instincts and emo-

tions. Intelligence and higher interests give place to the more fundamental biological needs and it is only when the more essential interests are satisfied that the higher intellectual interests dominate consciousness. Hunger and pain in the child will drive out all other interests, but when these are eliminated conscious activity quite naturally flows into other and higher channels, if interests along such lines have been built up. During the first or pre-social period the development of sensory and motor capacities takes place rapidly and the child responds to persons in an objective way. Most important in this period, however, are the growth and development of the body.

During the second period the sensory and motor development continue rapidly, but there is much greater development along intellectual lines. The ability to understand and use spoken language develops rapidly, and the child comes into closer contact and understanding with the people about him. He becomes more sensitive to the attitudes of his associates, *i.e.*, he is developing a social consciousness distinct from his consciousness of the external world. By the end of the period, the child has absorbed a great deal from his social environment in the way of language, customs, and habits.

In the third period the child becomes relatively less social and more individualized, *i.e.*, independent. While in the former period he was rarely satisfied when alone, he now finds satisfaction in independent activity and will often play alone with enjoyment. Imagination and curiosity develop rapidly and the child becomes a tireless questioner. His outlook on the world is broadening and he seeks information on all kinds of topics. His questions about scientific and religious topics are often hard to answer. Self-assertiveness is strong and often contra-suggestibility takes the place of the earlier direct acceptance of suggestions. the child often questions things, because he is now thinking

more than in the earlier period and he sees relationships to a much greater degree. By the close of the period the child's character has passed through its first formative stage and further radical changes do not take place until adolescence.

In the fourth period, that of competitive socialization, from 7 to 12 years inclusive, rivalry and competitiveness are strong, and association with other children is necessary for normal development. Undue development of the individual in undesirable directions is best suppressed by contact and conflict with other children of similar tendencies. Says Kirkpatrick: "Only through companionship with those like himself can the child learn the natural laws of sympathy, ridicule, rivalry, etc., that always come into play whenever human beings are associated with each other." [1]

Formal education now does much to aid in intellectual development, and towards the end of the period many children become omnivorous readers; but probably, after all, the greatest influence on the development of character is exercised by associates of the playground. The average youngster at this age is influenced much more by the example and opinions of other children than by his teachers. The teacher's opinion is, in fact, often held very lightly. Chumming becomes prominent and gangs develop. It is largely through such influences that personality develops. It is still essentially egoistic, and the coöperative group loyalty necessary for group games is still weak.

In the fifth or pubertal period there is a great awakening of the imagination, great increase in the ability to do abstract thinking, and especially a development of the sex and social feelings with a great increase in altruism and coöperativeness. The combined effect of the intellectual and emotional awakening is seen in a great broadening of interests and of the development of adult interests, especially in sex,

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[1] E. A. Kirkpatrick, *The Individual in the Making* (Boston, Houghton Mifflin, 1911), p. 166.

in religion, and usually in some vocation. The child is becoming the adult. The transition is at times accompanied by such emotional excitement and many emotional conflicts and so has come to be called "the storm and stress period." At the end of the period the character and interests are usually pretty well fixed. It is particularly important, therefore, that especial attention be paid to moral and religious development at this time. Studies of history and literature contribute particularly to moral development and studies in science stimulate the development of thinking. The literature on this period is very extensive and the reader must be referred to it for a more detailed treatment of the problems.

The final period of development is that of late adolescence. It is usually characterized by less emotional stress, though in some cases this does not hold. Generally the character becomes settled along lines already indicated, but in particular instances there is a change from radicalism to conservatism, or the reverse, from religion to scepticism, etc. These changes are likely to be the result of previous conflicts in the home or school. In such cases the change is not as real as it seems, for it is simply shifting from a tendency that has been expressed to one that has been inhibited.

After the age of 25, marked changes in character rarely occur and when they do are usually the result of most exceptional modifications of environment and experience. The adult usually takes up a particular mode of life, settles down, and, as far as his character is concerned, he remains relatively fixed. All of these characteristic changes, it should be noted, occur on the average earlier in girls than in boys, though there is much overlapping of the two groups.

McDougall's Three Stages

An admirable analysis of the development of character has been made by W. McDougall in his *Social Psychology.*

To that the writer is indebted in that it supplies the basis of the following discussion.

Conduct may be classified into three levels according to the degree of moral development of the individual. On the lowest level conduct is of the reflex and instinctive variety. It is controlled first by the satisfaction or dissatisfaction resulting from actual attempts to act and later by the anticipation of such results. Animal behavior and the behavior of infants are mostly of this kind. Such behavior does not involve the existence of self-consciousness.

At a later stage of development the child and doubtless the higher developed animals become responsive to social praise and blame. Conduct is motivated by the desire to secure praise or to avoid blame from associates. It is still based fundamentally on the instincts and emotions, but the social aspect of the child becomes more developed and the consciousness of self appears and is affected positively or negatively by blame. Children under 12 and even many adults do not get above this level of conduct. What they do is determined by their native tendencies modified by the effects of pleasure and pain and by social approval and disapproval. "What will people say?" is, indeed, a powerful determiner of conduct in nearly all adults.

The third and highest level of conduct may come with adolescence or it may not come at all, at least not to a great degree. At this level conduct is based on ideals supported by the *self-regarding sentiment*. A sentiment, it may be said, is an attitude resulting from the organization of both emotions and ideas around some object or idea. Sentiments are of three main classes: love, hate, and self-respect. Sentiments are not innate; neither do they appear suddenly. They are the result of growth and are based on the experiences of the individual. After suffering many injuries from a particular individual, a sentiment of hatred towards him may be developed. Likewise, as a result of a com-

bination of experiences, a sentiment of love may be developed. Love at first sight, so-called, is in reality the attachment of an already formed sentiment to a new object. All sentiments, be it remembered, are the results of growth. Not only may sentiments of love and hate be attached to persons but also to other things, including ideas. Love of country is thus a sentiment resulting from the same process of development as love of an individual. Love of truth or love of justice, likewise, is the result of a process of development. They are abstract sentiments and may influence one to work for truth or justice at all times.

The third sentiment, that of self-respect, involves the development through experience of a sentiment centered on the self and involving certain ideas as to what the self stands for. The self-regarding sentiment is normally a master-sentiment and includes within itself all other sentiments. It thus happens that when an individual has developed a love of country, the love of country is a very real part of his self and an insult to his country is an insult to his personality. The highest level of conduct is one in which sentiments of love, truth, justice, etc., are incorporated within the self-regarding sentiment and exercise a controlling influence on conduct so that what the individual does is determined by those abstract ideals. It is such sentiments that enable a man to become a martyr to a cause. Self-preservation in such cases remains the first law of nature, but it is preservation of the self as rated in the self-regarding sentiment, which means the attachment of much greater importance to the preservation of a reputation for loyalty, courage, and honor than to the preservation of life. When a person is actuated by such sentiments, he is no longer controlled by "what will people say?" If he believes a certain course of activity right, he follows it regardless of popular clamor. It is to this end that moral education should work.

In religious training, it might be noted, appeals are often made to children and often to adults on the first level, *i.e.*, by threats and promises of bodily pains and pleasures. With unintelligent men such a procedure is doubtless necessary, but it should be recognized that it is of a low order as a moral appeal. It involves no real inner development of moral character. A man does not have to be morally improved to be afraid of fire. Too infrequently is the attempt made to secure right conduct by developing sentiments of love for right. And yet it is only on this basis that it is possible to secure a high level of moral conduct.

The development of sentiments takes place slowly throughout the period of mental growth and the formation of character is a process of forming and organizing sentiments. It is just here apparently that environmental agencies may have their most important influence. The development of sentiments is, however, dependent on the development of the emotions and on the development of capacity for abstract thinking and so is limited by the maturing of innate capacities and tendencies.

MATURITY AND SENESCENCE

Maturity

We are commonly inclined to assume that there is a long period of maturity during which a man's capacities remain at a fixed level. This does not hold when carefully examined. Change is fundamental to all things biological: what is not increasing is pretty surely decreasing. The change may be slow and insidious but none the less sure. We should deal here, however, with specific functions rather than with generalities. One function may be increasing while another decreases. Capacity to recover from fatigue appears to decline practically throughout the whole life period. Endurance apparently increases until perhaps about

35, when it begins to decline. Motor plasticity and power of learning new coördinations appear to decline after an early age, and after 25 years really new coördinations may be practically impossible.

On the mental side there is apparently less early loss of capacity than on the physical side. If one can trust the opinions of some—and we have little more than opinions to go on—it seems that facility in some mental activities may continue to increase until relatively late years, *i.e.*, 50 years or even later. This holds, however, only for brain workers. The outstanding defect of maturity is the loss of mental plasticity with the resultant incapacity to develop new points of view. This has been emphasized by James on theoretical grounds and is supported by the verdict of history. New ideas are the product of untrammeled youth rather than of conventionalized maturity.

Senescence

The term *senescence* is reserved in the minds of many for a very old age—after 70 or 80 perhaps. The fact remains, however, that the average man does not live to such age. Physical and mental decline or involution begins much earlier. The period from about 20 to about 40 represents the real period of active manhood or womanhood. Before 20 is growth, after 40 is decline. Evidence and argument are unnecessary to convince any observant and thoughtful person that this is true in the physical field. Consider the professional ball players. If they survive to 40, it is recognized that they are marked for early retirement. The same result is found in the military field. Only comparatively young men can stand the strenuous life of a hard campaign.

The fact of physical involution is known not only in the decline in performances but in changes in body organs. Some of the involutional changes in women are marked

and are well known. Similar though less acute changes occur in men. The brain does not escape this general process. Neurologists have pointed out that with advancing age there is a loss of nerve cells in the brain. The writer (1919, 1920) has measured this quantitatively in case of the Purkinje cells in the cerebellum. Beginning at about the age of 40 years, though often earlier, they begin to disintegrate and disappear. The same kind of process takes place in the cerebral cortex, though it has not been accurately measured. The most important evidence of change in the cerebrum in senescence is found in the decline in the gross weight of the brain. According to Boyd's results there is an average loss of about 100 grams by the age of 75 years. This is almost certainly due in part to the loss of cortical cells, their axones and myelin sheaths.

A further point of importance in interpreting old age is the fact brought out by Pearl and others that length of life is in a very important sense inherited. This does not mean, of course, that one inherits 22 or 57 or 94 years of life: it means rather that we inherit inferior, mediocre, or superior constitutions which will ordinarily make for short, average, or long lives. The tendency to disintegrate is apparently inherent in the organism and it is merely a question of time before this happens. If it happens that the circulatory system is the weakest part of the individual, death may occur before any appreciable mental weakening. If the nervous system is the weakest part, there may be marked nervous and mental disintegration before death. Great variation in the nature and extent of the involution processes in different individuals of a particular age is to be expected.

Mental measurements have not yet been applied to enough people past 40 for us to be able to judge accurately how test performances would compare at different ages. We are, therefore, forced to base our judgments of mental capacities during senescence mostly on other data. The

outstanding things seem to be a relative weakening of memory, of originality, and of initiative. Adjustments to new ideas are made with increasing difficulty or not at all. Familiar ideas are still managed in many cases with great efficiency and very old people may do work of great difficulty and value in fields with which they have had considerable experience.

Beyond this general statement it does not seem wise to go on the basis of our present information. It should, however, be clearly recognized that from a scientific point of view senescence presents problems quite as real and quite as important as those of growth. The whole life cycle is a unitary and ever changing process.

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CHAPTER X

SEX DIFFERENCES IN MENTAL TRAITS

Man's Claim to Superiority

As Jastrow has pointed out, this is a man-made world. And this characteristic of being made by man applies not only to the roads, buildings, and machinery about us; it applies also to a considerable extent to our knowledge, our opinions, and our art, including literature. The history and the scientific theories we read are for the most part the expressions of men. And men are not generally noted for their modesty when passing judgment on their own abilities. It is thus not surprising, if indeed it is not to be expected, that a survey of historical views on the question of sex differences would show that men have [illegible] credited with greater intellectual capacity than women. There were few literary and scientific opponents of the idea of masculine superiority, and so it remained an unproved but generally accepted dictum until recent times.

The maxim that might makes right may be offensive, but in the long history of man there can be no question that might has often prevailed and caused an erroneous idea to be accepted, for a time at least, in preference to the correct one. Because of his superior brawn man has long imposed his will and his opinions on woman, and finding her weaker physically he has considered her weaker mentally. Furthermore, the biological differences between the two sexes have in a measure forced women to be home-keepers while men have been forced into a wider environment. This has broadened man's mental horizon by giving him more varied

contacts and a wider assortment of information than that possessed by the home-keeping woman. And man has not missed the opportunity of ascribing his broader knowledge to a supposedly greater *capacity* for absorbing knowledge. Furthermore, with the advance of civilization, specialization has taken place in the work of men but not in that of women. As this has developed, it has become necessary for the boy to go through a period of training before entering the work of his trade or profession. It has, in short, been practically necessary to give the boys of the upper classes an education. But in case of the girl the same has not applied. The work of home-keeping has not reached the point where it *requires* a period of technical training. So much is this true, in fact, that our educational system today pays but little attention to the study of home-making as a part of the curriculum for girls. Some, in fact, of our so-called best colleges for girls offer nothing that will fit a girl directly and specifically for home-making. As a result of the difference in the practical necessity for educating boys and girls, girls have almost universally (excepting only the United States in recent times) received less education than boys and have been supposed to be less educable. This inference followed quite naturally, though not logically, the observation of the fact of differences in actual accomplishment.

With the development of more exact mental measurements the claims of feminine inferiority have been received with skepticism, and science has failed, as it so often does, to support the opinions of the past.

PHYSICAL SEX DIFFERENCES

Turning then to the scientific data bearing on the question of sex differences, we shall first consider some of the physical differences between the sexes.

Height and Weight

For comparative purposes it is best to take adult heights and weights before the age of 25 because with increasing age there is often an increase in fatty tissue which is of no significance for our purposes. College students are probably somewhat above the average for the general population, but probably the difference between the sexes is about the same as for other groups. The differences in height are usually about 4 inches and in weight about 20 pounds. There is some variation in different sections of the country in the absolute measurements. This is due largely perhaps to differences in the nationality of the students. North European stock is usually somewhat taller than South European stock.

In addition to the difference in height and weight, there is also a difference in relative proportions. In women the trunk is relatively longer and the limbs relatively shorter than in men. This indicates that men have a more developed motor mechanism, women a more developed vegetative one. This view is supported further by the fact that there is a difference between the sexes in the relative amounts of muscle and fat. Men have more of the former and women more of the latter. It is this fact that makes women better able to resist cold. The greater amount of fat also makes them lighter in the water. These two factors are largely responsible for their excellent showing as swimmers.

It thus appears that the metabolism of women is more anabolic while that of men is more katabolic. Women have a relatively greater energy reserve than men and can endure more than men, except in the field of muscular activity, where men have both more strength and greater endurance. In such matters as going without food or sleep, however, and still keeping on with their activities, women appear to have greater endurance.

Rate of Growth

Among the most interesting physical differences between the sexes are the differences in rate of growth. At birth and as adults males are taller and heavier than females, but the rates of growth are different. Girls grow more rapidly than boys and mature earlier. This difference begins to appear more particularly at about the age of 9 years in girls when a pre-pubertal acceleration in growth takes place. In boys this does not occur until about 2 years later. As a result the differences between the heights and weights of the sexes are reduced, and at the age of about 13 the girls are both taller and heavier than boys of the same age. Girls continue to grow relatively more rapidly than boys and by the age of 15 they are about 97 per cent of their adult height and nearly 90 per cent of their adult weight. Boys at 15 are only about 92 per cent of their adult height and 76 per cent of their adult weight. These differences are brought out in Figure 34.

Brain Development

Brain Weights.—The average weights of the brain for men and women given by different investigators vary considerably. This is doubtless due partly to the impossibility of securing a really average sampling from the general population and partly perhaps to actual differences between different populations studied. The women whose brains are removed and studied are probably in general somewhat inferior to the corresponding group of men. On the basis of the results at hand, 1,400 grams for men and 1,250 grams for women may be accepted as reasonably accurate. This gives women a slightly heavier brain than men when considered in relation to body weight.

Head measurements by Porteus have been used to support a different conclusion. In criticism of his results, however, we may offer in part the same kind of objections as

has been offered against phrenology. An adequate study of the relation of brain size to head size on an unselected group of women has never been made and cannot under present conditions be made. Yet until we have such results, we are not justified in concluding much as a result

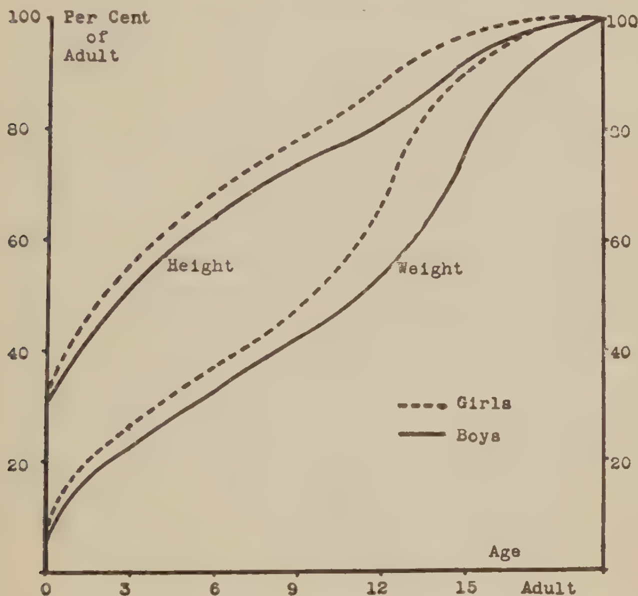

FIG. 34.—GROWTH IN HEIGHT AND IN WEIGHT OF GIRLS AND OF BOYS. (Based on data from Tyler.)

of the study of head sizes. The skin, subcutaneous tissue, skull, and cerebrospinal fluid are sufficiently variable in thickness or amount to make impossible a safe inference from head size to brain size until we have accurate measures of these variables and especially of any average differences between the sexes in this regard.

Brain weight must be considered in relation to body weight to be at all significant and, as stated above, when so

considered the brain is as heavy or heavier in females than in males. The skeleton in males is heavier than in females and the fact that head measurements are found to be larger in men than in women need not be considered any more seriously than the fact that measurements of the feet would give a similar result.

Relative Size of the Cerebrum and Cerebellum.—The writer (1920) has had occasion to review the scientific literature dealing with the relative sizes of the cerebellum and cerebrum. Some anatomists, convinced of the intellectual inferiority of women, have endeavored to support this by comparing the relative weights of the cerebellum in men and women. Their idea was that the cerebrum as the organ of thinking should be relatively larger in men than in women. They accordingly claimed in some cases that the average of large numbers of brain weights showed a relatively larger cerebellum in women. A review of the various studies in this field in several countries, especially England, France, and Germany, shows, however, no significant difference in the relative weights of the parts of the brain in the two sexes. The results of different investigators vary, but an average of these gives a value of about 10.8, *i.e.*, the cerebellum in both men and women averages about 10.8 per cent of the weight of the encephalon.

It may be noted in passing that this same theory of a relatively large cerebrum and a relatively small cerebellum as an indication of intelligence was applied by Spitzka to the difference between the brains of men of different levels of intelligence. An actual comparison of cases, however, shows no significant difference between mental defectives and superior men in this respect. Both show a rather wide range of variation in these ratios. There is, therefore, no basis whatever for attempting to show that women are less intelligent than men by showing a difference in the relative size of the cerebellum.

Number of Neurones.—In the last analysis, the question of brain differences reduces itself to that of the number of nerve cells and the degree of their development. Even if it should be shown that men have relatively larger brains than women, there would still remain the possibility that differences in internal structure would keep the two equal in efficiency. Certainly this is the case with many individuals. It could be true of the average difference between the sexes. The writer does not think such a difference exists but suggests it as a further reason for being cautious in drawing conclusions from head sizes.

Nothing certain is known as to differences between the sexes in numbers of nerve cells. In the writer's studies of the Purkinje cells in the cerebellum a smaller number was found in female brains, but due to the character of the material it is unsafe to claim that this is a normal difference. If further studies showed this to be a real difference, the interpretation of it would have to be in terms of the motor rather than of the intellectual capacities of the sexes.

Our conclusion is, then, that the study of the nervous system has not yet supplied any satisfactory evidence for supposing that either sex is more intelligent than the other.

Glandular Differences

Certain differences in the glands of internal secretions in the two sexes seem fairly well established. Other differences are plausible but not established. First and foremost is the differential action of the testes and ovaries in determining the primary and secondary sex characteristics. It should be recalled, too, that this difference in development depends on the inheritance of an XX pair of sex chromosomes by females while males inherit an XY pair. This will help us to understand how the destruction of the ovaries in females causes loss of female characteristics and the development of masculine characteristics. The female

is genetically a male plus certain factors that inhibit the development of specific characteristics peculiar to the male and cause the development of the female characteristics. This point cannot be too much emphasized in dealing with the biological differences between the sexes. Male characteristics, both physical and mental, are due chiefly to the absence of certain determiners present in the female.

Of the other glands that are known to have an important influence on mental life, the greatest known sex difference is found in case of the thyroid. Thyroid disease is more common in women. In experiments on lower animals the removal of the thyroid has had a more serious effect on the development of females than on the development of males. The thyroid undergoes certain changes in pregnancy. Such facts tend to show that the thyroid is more essentially a female organ. The greater activity of the thyroid is one of the probable causes of the greater excitability of women, because the effect of thyroxin on nerve tissue is to increase its excitability. This overactivity is found to the greatest extent in exophthalmic goitre, which is more frequent and more serious in women.

The anterior pituitary body is known to regulate the growth of the skeleton and one might infer from this that it is more active in males than in females. There is some evidence also to show that it stimulates the growth of the nervous system. Any difference here is apparently in favor of the male, while any normal difference in thyroid activity appears to be in favor of the female.

It seems very probable that future research will show further differences in the relative importance of the internal secretions of men and women, but at present we have little evidence to support the various guesses that are being made in this field. As far as the evidence goes, it tends to support the idea that women are somewhat more emotional than men.

Summary of Physical Differences

If we summarize the better known physical differences between the sexes, we may say that men are taller, heavier, more muscular, and show less tendency to put on fat; there is no certain significant difference in the nervous system; specific differences in growth are largely controlled by the differential action of the sex glands; the thyroid is more important in women, the anterior pituitary is probably more important in men; girls mature physically two or three years earlier than boys.

HISTORICAL EVIDENCE ON SEX DIFFERENCES

Historical Achievements of Women

Passing from the biological differences between the sexes it will be of some interest to compare the historical achievements of the sexes. How in comparison with men have women acquitted themselves? Some endeavor to answer this question by comparing the achievements of distinguished men with those of distinguished women. This comparison we shall discuss later, but it is clearly an unfair basis of arriving at the separate accomplishments of the sexes, since only a fraction of 1 per cent of the total groups are considered in such a classification. The real question is: What is to be recorded to the credit of the average man and the average woman in history?

History, it happens, tells us little about the average citizen—either the male or the female. Only by a process of inference and mental reconstruction can we gain an idea as to the accomplishments of the average men and women in remote times. Study of more recent and better known primitive peoples will also help us here.

The American Indians are, perhaps, a not unfair example of primitive peoples and their methods of living are best known. The men, it seems, were good at hunting,

fighting, eating, resting, and sleeping. If resting became too monotonous or times too hard or the work too heavy for the women, the men may at times have done some work, but apparently they did not do a great deal. To the credit of the men then we may chalk up so much food consumed, so many hours passed in peaceful rest, and so many wild animals and enemies killed. The women, it would appear, bore the children, raised them, cooked the food, engaged in some primitive agriculture, and did most of such other work as was done. Between the two, it seems that the work of the women was the greater and required the greater intellectual powers, while the activities of the men required or placed a greater premium on physical prowess. Consider the world at large today. How different is the picture from that of the early American Indians? On the whole, the men spend somewhat less time resting and rather less time fighting, but the idea of the 8-hour-day (or less) receives the most active support of the male sex. While men in civilized communities have taken to more or less regular work, it cannot be said that the work of the average woman has so materially lightened. Readers in some American circles will no doubt question this, but it is written with reference to women in general and so includes Japanese, Chinese, German, Italian, French, Irish, and others, the masses of whom do a great deal of heavy work, as do a considerable part of the women in America. Women's other activities, as bearing children, rearing them, preparing food, and doing other household work, are very similar today to what they were in earlier times. Certainly when the work of the masses is considered, it cannot be said that the work of the average woman requires less intelligence than the work of the average man. Consider even the skilled trades today. No more intelligence certainly is required of the plasterer in his trade than is required of his wife in her household duties. Certainly the rearing of children, the

major burden of which has fallen to women, requires quite as much intelligence and endurance as does the work done by the average man. Of course, children may be reared unintelligently, but so may men's work be done unintelligently. If the matter be considered in this light, the masculine historian will find little cause to boast of masculine superiority.

Greatness in Men and in Women

When we turn from a consideration of average individuals to exceptional individuals, we encounter the undeniable fact that history as it is written—by men—leads us to believe that there have been more exceptionally great men than women. This may correctly represent the true fact—the writer frankly does not know—or it may be that it is true only with reference to certain kinds of greatness and not true with reference to others. Certainly there is no question that in a military way men have been the leaders. In political life, which has very often involved military connections, men have also been the leaders—and a large part of the great men of history have been great in either military or political affairs. It is also true that in science, in art, in philosophy, most of the great names have been those of men. But this is not necessarily due to differences in inherent genius. Greatness in science, literature, and art has ordinarily involved education and special training which has until recently been denied to women. Furthermore, the great man of science is not ordinarily an isolated figure toiling on a solitary path to scientific greatness. He is usually associated with other men who stimulate him and reward him with praise when successful. Women have as a result of conventional attitudes, customs, and prejudices been denied these stimulating contacts. It is thus not surprising that they have done so little. Also it should be remembered that, historically, women have been expected to marry and

when married to subordinate their own ambitions to the careers of their husbands. All environmental circumstances have thus been against them. Scientifically it is, therefore, difficult if not impossible to appraise in a just manner how much of the difference in the numbers of great men and women recorded in history is due to native qualities and how much to environmental factors.

Circumstances have in a number of cases placed women at the head of great states and in several of these they have displayed extraordinary capacity. Of such type were Elizabeth of England and Catherine of Russia. It is also true that some queens have been weak and inefficient rulers, but it should be remembered that the number of inefficient masculine rulers has been legion.

The field of letters and of the arts in general would seem to be open to women to a greater degree than the field of politics. And women have furnished a few great names here, though not so many perhaps as might be expected. But as literature must depend on the experience of the individual, it seems evident that the limitations in the experience of women would handicap them in the field of literature as well.

In one artistic field, singing, women would appear to be conspicuously ahead of men. This may be associated with a relatively greater development of the vocal cords in women and also probably with their greater emotional development.

In science women have furnished few leaders; but that scientific distinction is not incompatible with being a woman is shown, for example, by Mme. Curie.

In philosophy there is no case of a woman who has attained first rank. The history of philosophy taught is the history of masculine thought. Few women have invaded the field. This would agree with the view of those who hold that women are little interested in generalities. Also the greater emotionality of women would tend to prevent

the attainment of the state of philosophical calmness necessary for the most successful speculation.

In the discussion of genius in a later chapter we shall refer again to the relative numbers of women who have attained distinction, but enough has been said here to show that as greatness has been rated during history there have been fewer great women than men. However, if history were written by women, it may well be questioned whether such a relationship would hold.

EXPERIMENTAL EVIDENCE ON SEX DIFFERENCES

The experimental evidence of sex differences is open generally to the criticism that the groups studied do not represent random selections from the general population. Only in the early grades is it possible to get a fair comparison of the sexes, and even there it is necessary to do so by taking all children of given ages rather than all of given grades, because of the selective effect of promotions. In high school we have a severely selected group often with about twice as many girls as boys. The boys are, therefore, much more rigorously selected. In college the selection of boys and girls is on a somewhat different basis, and so it becomes quite impossible to estimate how these groups compare with the general population. These selective factors may destroy the value of results based on very large groups. When, however, the groups studied are small, the probabilities of statistical error are so great that it becomes impossible to take the results seriously. For this reason no importance can be attached to some of the studies that have been made. One study was based on only 10 men and 10 women; another much quoted study was based on 25 men and 25 women. Such studies may, of course, happen to point to correct conclusions; but the danger that they will not do so is too great to permit us to

attach much importance to them. The determination of small quantitative average differences between two greatly overlapping groups requires a very large number of cases.

There are two distinct problems in the determination of sex differences: First, there is the problem of differences during the period of growth, and second, there is the problem of differences in adults. We shall discuss these in turn.

Differences in Rate of Mental Growth

Pyle's results on the growth of boys and girls generally showed the girls to develop earlier than the boys. This has been illustrated in Figure 35 for the learning of symbol-digit and digit-symbol associations. The results of these two tests have been combined, then smoothed, and finally converted into percentages of the adult performance. From these results the growth curves have been drawn. By comparing this figure with Figure 34 it will be seen that after the age of 8 years, where the observed growth curve for learning begins, there is a very marked similarity between the curves for physical and for mental growth. Below the age of 8 years it is probable that there is a difference in the form of the growth curve for this kind of learning as compared with the growth curve for height and weight. A hypothetical curve has been plotted up to the age of 8, but it is only a suggestion. If we were dealing with other forms of learning, it is probable that there would be a rapid rise in the curve during the first few years instead of a slow one as here illustrated. The similarity to the growth curve for height or weight would then be more complete.

The uniformity in Pyle's results on different tests affords considerable basis for the view that girls develop mentally faster than boys, just as they are known to do physically. When, however, we turn to results from the application of tests consisting of a large number of items or elements, such

as the Binet and Army Alpha, we do not find the same kind of result.

The Terman revision of the Binet shows a slight superiority on the part of the girls. The Yerkes point scale does not show any regular difference between the sexes.

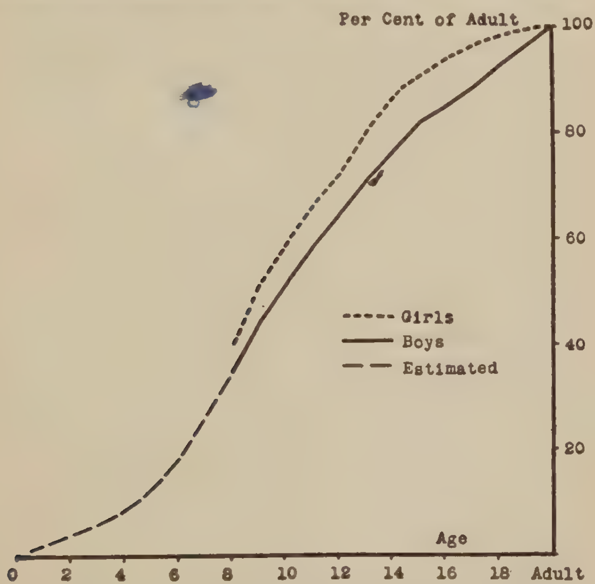

FIG. 35.—THE GROWTH OF LEARNING CAPACITY IN BOYS AND GIRLS AS MEASURED BY SYMBOL-DIGIT AND DIGIT-SYMBOL TESTS.

The graphs after 8 years are based on Pyle's data. Before 8 years is estimated.

Army Alpha tends to show boys superior to girls. Most of the group tests do not show any very great difference. From this it is evident that, in part, the results obtained in comparing the sexes are due to the tests used: they are not to be taken as certain sex differences without further interpretation. It will be pointed out later that in some things girls appear to be superior to boys while in other

things the reverse is true. It would thus be possible, other things being equal, to construct two tests so that one would show girls superior and the other would show boys superior. Furthermore, if the girls are actually more precocious than the boys, it would be possible to reduce or to eliminate this difference by giving a test especially adapted to boys. This may be the explanation of the failure of particular tests to show any conspicuous sex difference.

Another line of evidence bearing on the question of sex differences in rate of development is found in school enrollment and promotions. As is well known, there is a decrease in the relative number of boys in each grade from the first to the twelfth. This might, of course, be due to factors other than to differences in intelligence, but it is difficult to escape the belief that, in part at least, it is due to a difference in mental level, caused in this case by a slower rate of mental growth on the part of the boys. Figure 36 illustrates how this would work out. If the girls grow faster than the boys, the distribution of the mental ages of the girls of a given chronological age would have a central tendency above that of the distribution of the boys of the same chronological age, though there would be considerable overlapping of the two distributions. Failures in a given grade of school work would undeniably be related to mental capacity, and so it would happen, other things being equal, that more boys would fail. This is illustrated in the figure by assuming the point *A* to represent a critical level of ability for this grade. Cases falling to the left of the line *AB* are naturally much more likely to be eliminated or failed, and so by a process of selection the numbers of boys in the upper grades would be progressively reduced. The average capacity of the boys who were promoted would, however, be about as high as that of the girls. Furthermore, by the end of the high-school period, after the boys had practically completed their mental growth, it might well happen

that the average mental level of the surviving boys would be higher than that of the surviving girls, because more of the less intelligent girls would have been able to secure regular promotions. If we refer back to Figure 20 (p. 123) and compare the scores of a group of high-school students on Army Alpha, we find that, while the central tendency of the boys' scores is higher than that of the girls' scores, the real difference between the two distributions lies in

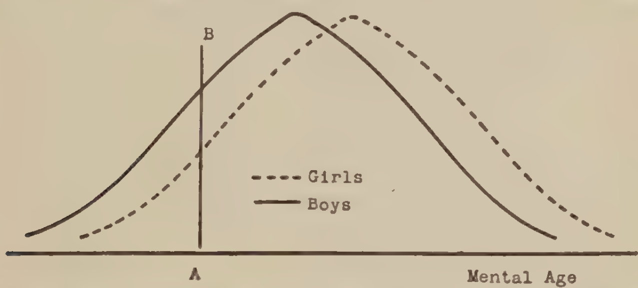

FIG. 36.—THE EFFECT OF MORE RAPID GROWTH BY GIRLS ON THE DISTRIBUTIONS OF MENTAL AGES OF BOYS AND GIRLS OF A PARTICULAR CHRONOLOGICAL AGE.

For discussion, see text.

the fact that there are more girls with low scores and not in the fact that there are more boys with high scores. There are just as many girls, as a matter of fact, with high scores as there are boys. This at least agrees with the idea that the boys have continued to grow fairly rapidly after the rate for the girls has slowed down. If, on the other hand, we make the common assumption that Army Alpha is somewhat unfair to girls, then we must conclude that the most intelligent girls are actually more intelligent, *i.e.*, mentally more mature, than the most intelligent boys. Thus either assumption supports the idea of precocious development on the part of the girls.

In this same connection it may be worth while to note

that in the group studied there are 54 girls less than 15 years of age, while there are only 28 boys. Similarly, there are 60 girls and 76 boys aged 18 years or more. In both cases the figures support the idea of feminine precocity.

For the present it is doubtless wise not to accept too implicitly any conclusion as to sex differences in rate of mental development. At the same time we know with certainty that girls mature physically two or three years earlier than boys. There are also various kinds of evidence of earlier mental development, though the evidence from mental tests is not uniformly in support of such an idea. The contrary evidence is, however, of such a character that further analysis may well show that it, too, is consistent with the idea of an important sex difference in rate of development. What is needed is a study of sex differences in specific capacities with as careful a control as is possible of selective factors which might themselves cause differences in the results.

Adult Differences

Despite the statistical defects of studies of sex differences, it appears fairly clear that in certain activities the average man is superior to the average woman, while in other activities the average woman is superior to the average man. As an illustration of these differences we may compare the performances of college men and women on tests of arithmetical reasoning and of artificial language. Figure 37 shows the scores of 514 women and 716 men on the Cooperative Arithmetical Reasoning Test after smoothing both distributions and reducing the distribution for the men to 514 cases by multiplying the frequencies in each case by .718. This makes the distributions easier to compare fairly. From this it is evident that the average man is somewhat better than the average woman, but the difference is not a great one. The overlapping of the two distributions is

more important than the difference in central tendencies. Figure 38 shows the scores of the same group on the Artificial Language Test. The graph has been plotted in the same way. In this case, however, we find that the

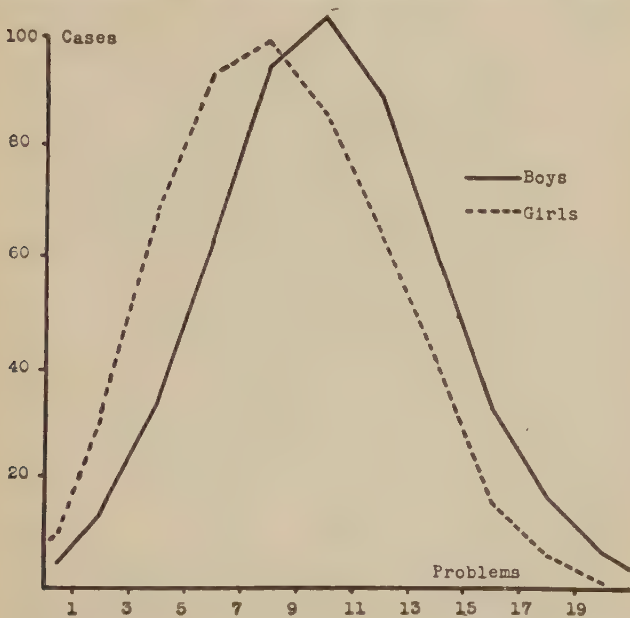

FIG. 37.—THE DISTRIBUTION OF THE SCORES OF COLLEGE FRESHMEN ON A TEST OF ARITHMETICAL REASONING.

Based on 514 girls and 716 boys, but the distribution for the boys has been reduced to 514 cases by reducing ordinate values to .718 of the original. Both distributions have been smoothed.

average woman is better than the average man. In the same way other distributions could be shown with men showing a higher average in some capacities and women showing a higher average in others. In general the motor capacities of the average man are superior to those of the average woman. The sensory capacities of the average

woman are generally superior to those of the average man with the exception of kinæsthetic sensations. The average woman is somewhat better in memory, especially rote memory. The average man usually does somewhat better

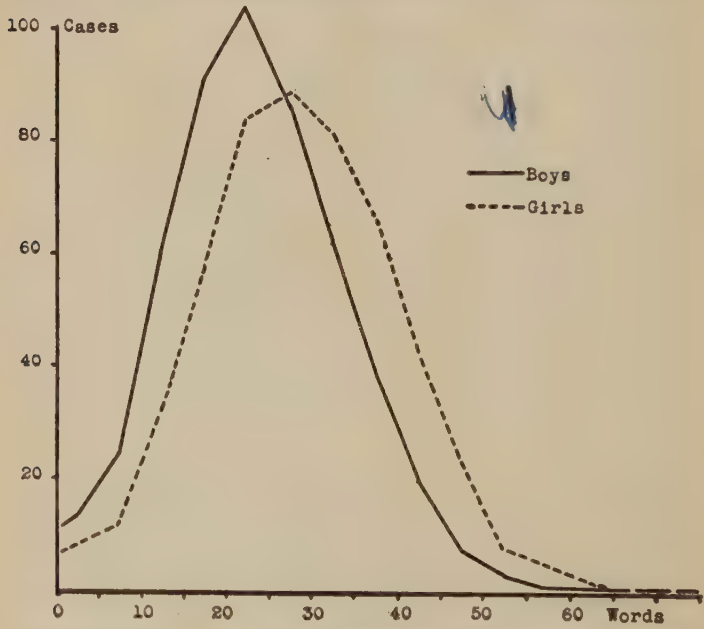

FIG. 38.—THE DISTRIBUTION OF THE SCORES OF COLLEGE FRESHMEN ON A TEST OF ARTIFICIAL LANGUAGE.

Based on 514 girls and 716 boys, but the distribution for the boys has been reduced to 514 cases by reducing ordinate values to .718 of the original. Both distributions have been smoothed.

in tests of "originality." In such comparisons, the differences found between the average man and the average woman are usually small, there is much overlapping of the two groups, and the important result is, therefore, that sex differences are much less important than the differences found between members of the same sex.

Differences in "General" Intelligence

From the evidence already submitted it should be clear that the result of a general intelligence test will depend on the character of the test as well as on sex differences. This is well brought out, for example, in the results of the Army tests when given to men and women. The men have usually averaged about 10 per cent better than the women, but this is interpreted as being due to the character of the test rather than to any innate sex differences. It may be due, however, to selection of the cases tested. Other tests do not show any significant difference between the sexes when representative groups of college students are taken. Nor is it likely that future tests will show any really significant average differences except in particular specialized abilities. The mechanism of inheritance gives us good reason to believe that the mental traits of the sexes are genetically alike, except for differences introduced by the pair of sex chromosomes, and nothing in our present knowledge would cause us to believe that this difference would make any considerable difference in mentality. Such differences as exist seem to be largely affective and emotional.

From a purely statistical point of view it is unlikely that in the near future we shall have adequate data from mental measurements for a reliable comparison of the mental capacities of the sexes, because it is virtually impossible to apply tests to a sufficiently large number of cases that have not been selected by factors affecting intelligence.

Differences in Scholarship

Attempts at a comparison of the capacities of the sexes have also been made by comparing the grades in different school subjects. Such studies are of uncertain value because so many factors are involved. Nothing is stated as to the amounts of time spent by the two sexes in study

for the various courses. And if it should happen that boys spend less time than girls in studying their work, it would clearly not be a comparison of simple intelligence when we compare the grades made. We must also remember that important selective factors are operating to make the abilities of the members of a class fairly uniform. School grades often show higher averages for girls than for boys, but it is fairly certain that this is in part due to difference in effort. The writer has on several occasions determined the average school mark made by boys and by girls who made the same score on an intelligence test. Invariably this has shown that the girls make a better school mark for a given intelligence score. Athletics, picture shows, and other non-scholastic interests receive a greater part of the boys' time. When subjects are compared, it is usually found that girls do somewhat better work in languages and boys in natural sciences, especially physics. This result would seem to agree with the differences in memory and in ingenuity found in the experimental comparisons of the sexes. The difference may, however, be due quite as much to a difference in experience and interest as to a difference in capacity. In any case, the difference is so slight that it would appear to be of theoretical interest only.

Differences in Variability

Granting that the average performance of the sexes is about the same, is there perhaps a difference in variability? Some have endeavored to account for the greater number of men of genius by assuming that men as a group are more variable, *i.e.*, that there is a greater number of very bright and very dull men, but that women are somewhat more closely grouped around the average. Thorndike submits various kinds of evidence to support this view and reaches the conclusion that women are perhaps

95 per cent as variable as men. This conclusion is based on a study of the performances of the sexes on certain tests such as the A Test, A-T Test, Easy Opposites Test, Memory of Related and Unrelated Words, tests of spelling, addition, and multiplication, school grades, and enrollment by ages in particular grades.

One of the results of the greater male variability would be a greater number of male defectives, and the statistics show that there are actually more boys than girls in institutions for mental defectives. It is also evident that there are more men than women in jail. While the latter fact might be due primarily to environmental differences, the former would ordinarily be attributed more to heredity.

Dr. Leta S. Hollingworth disagrees with the conclusion that there are more male than female defectives and endeavors to explain the difference actually found in institutions as being due to differences in the economic pressure on boys and girls. A female defective, according to Dr. Hollingworth, is more likely to be sheltered at home and not considered defective, while a defective boy will demonstrate his defectiveness when he starts out to earn his living. Undeniably selective forces may affect our statistics of variability as well as of other measures and it may be that Dr. Hollingworth is correct. The present writer inclines to the view that males are more variable. *A priori* an argument for greater male variability may be offered from a consideration of the mechanism of inheritance. Since males have one smaller sex chromosome, some of the factors of the paired chromosome would not be modified in their action by paired or allelomorphic factors, with the result that any combination of unpaired factors for weakness would produce a weaker individual and any unpaired factors for strength would produce a stronger individual than in the case of females, where factors for very weak traits would ordinarily be recessive to stronger

ones and where factors for strong traits would be weakened by recessives. Since chromosome combinations for 23 pairs would be the same for both sexes, there should be no difference in variability except that produced by the 24th pair. *A priori* there should be a real difference on this account, but it is evident that it should be small. If this is the basis of a difference in variability, we should find a limited number of women who would be quite as able as the most able men, but the number of exceptionally able women would be less than the number of exceptionally able men.

Differences in Supporting Qualities

Experimental and statistical studies have not as yet supplied us with data which account for or bear very directly on the actually observed differences in general behavior and performance of the two sexes. Various interpretations of this difference have been given, but the one by Jastrow is most satisfactory to the writer. His view is that the differences in attainment are not due to differences in intellectual ability, because tests show these to be about equal in the two sexes; they are due rather to *supporting qualities* and these are of two kinds: influences of the environment and influences of the emotions.

There can be no question that environmental factors bear on boys and girls in different ways. Boys are led quite naturally to look forward to a trade, business, or profession. They find certain qualities characteristic of men expected of them. Girls, on the contrary, in spite of all that may be said by modern advocates of sex equality and feminine independence, are led quite naturally to regard marriage as their proper destiny and vocation. Furthermore, certain virtues and methods of behavior are constantly held up to the girl as examples for her imitation.

At 17 she must avoid the kind of noisy behavior which in her brother even at 20 would excite no particular comment. As a result of this, the girl finds herself molded gradually by environmental forces to accept certain standards and certain interests and certain ideas. Outside of this approved group she dare not go for fear of losing her social standing—and all possibility of a husband from her social class. Environment does in reality virtually force women to accept certain standards. That this would reduce feminine variability in certain directions is evident.

Emotions and Achievement

In addition to the effect of environmental differences, differences in native emotional and instinctive make-up have a great effect on the interests and activities of men and women. Men are more pugnacious than women and they are also more self-assertive. There are other emotional differences, but these are of most importance, aside, of course, from the fundamental differences in the sex and parental instincts and emotions.

The importance of pugnacity and self-assertiveness in achieving distinction is ordinarily very great, because distinction involves overcoming numerous obstacles and the individual without self-assertiveness and pugnacity will not last long. This is particularly true in political and military affairs and is perhaps only a little less so in many other fields of work. Persistence in overcoming obstacles is necessary in all fields of endeavor. Even in the arts, only great and prolonged effort will result in work of exceptional quality. The emotional characteristics of women thus seem less suited to the strenuous and determined effort necessary for superiority over male competitors. Furthermore, women suffer in most enterprises from a greater or less conflict of interests. It can hardly be said that marriage and children mean as much to men as to women. The

emotional life of woman appears to be more vitally related to the maternal tendencies. If this is true, women devoting themselves to careers will suffer more from emotional conflicts and divided interests and so will be less able to give all of their thought to the work in hand. Not only does this apply to the higher grades of success such as we call genius, it applies to more ordinary activities. Men, because of their love of competition, make of business a game and put forth more effort than they otherwise would put forth. The deadly competition that often results makes business enterprise still less suited to women.

A further sex difference is maintained by some to exist in the degree of objectivity attained in thinking. According to these, women think in personal and concrete terms, men think in terms of general principles and abstractions. Women are more influenced by the emotions and men more by rational considerations. Men would probably generally agree with this, while many women would strongly disagree. On the whole it seems to agree with popular opinion. Environment has here, however, a very potent influence. Throughout history, women have secured their wants largely by influencing other people, chiefly men. Men have more often been forced to cope with the forces of nature. With human opposition a display of emotions is often a very effective mode of attack, and women being physically weaker have placed great reliance on that method. In coping with nature an emotional display avails nothing, while a cool head and a steady hand will do much. Men are thus forced to the development of a more objective point of view and to self-control. The environment of men in this way accentuates the native difference between them and women. When women are actually placed in conditions requiring control over natural forces, they have often shown marked ability, and it is not improbable that the accidents of their training rather than

native differences are largely responsible for the observed differences in behavior.

Environment and Education

An excellent example of differences in accomplishment due in large measure to environmental factors is found in the educational attainments of the sexes in different countries. In most foreign countries men are better educated as a group than women. In the United States the same situation does not exist. More girls than boys are in our high schools and more girls are high-school graduates. The difference between the sexes in different countries clearly cannot be due to native sex differences in intelligence. It must be due to differences in opportunities and in stimuli to get an education. Our conventional high school is perhaps more adapted to the interests of girls than to those of boys. The writer believes, however, that a difference in the rate of mental maturing is more important than anything else in determining the superiority of girls in high-school work.

Summary of Mental Differences

In conclusion, the experimental study of sex differences has revealed a few slight average differences of minor importance in the field of intellectual processes. The greatest differences appear to be in the as yet unstudied fields of instinct and emotion. There is probably an important difference in the rates of mental growth for the sexes but this is not established. Aside, however, from the specific sex differences and their mental concomitants, we would emphasize the point that sex differences are of much less importance than the differences found between members of the same sex. The differences in the performances of men and women may be accounted for in large measure by differences in the influence of environment.

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CHAPTER XI

RACE DIFFERENCES IN MENTAL TRAITS

Race Prejudices

Whenever in human history races have encountered each other, conflicts have resulted. Race prejudices appear to have existed since early history: they have probably existed as long as separate races have existed. Each race has been inclined to consider itself the chosen people. Its god, its religion, and its culture have been believed destined to become dominant over all rival gods, religions, and cultures of other races. Yet thus far no one god, no one religion, and no one culture have succeeded in overcoming all rivals among other peoples. Racial animosities have persisted and these have been reflected in the estimates made by members of one race of the intelligence and other characteristics of other races. The white man prides himself on his white skin; the native African considers a white skin a sign of weakness. In China the man or woman who marries a European or an American is disgraced, and in Europe and America something of the correlative of this attitude prevails. Such hostility is not confined by any means to antagonisms of color: it exists between different groups of the same color. Witness the attitude often assumed towards the Jews, or the literary and scientific battle waged over the comparative merits of the Nordic and other European stocks. It is, therefore, difficult in discussing such questions to maintain the neutral and disinterested attitude which is necessary to arrive at accurate conclusions.

A reaction from the popular attitude is found in the work of such men as Boas and Chamberlain who have been led to deny the popular opinion on the inferiority of other races. In so far as this is based on a recognition of the prejudice on which such estimates are based, it is, of course, a sound scientific attitude. The burden of proof rests on those who maintain race differences. But in the writer's opinion the attempt to maintain *equality* of races without adequate evidence is no more warranted than the rival view. In this direction Boas has gone too far. As it would take us too far afield to review his argument, the interested reader is referred to Boas's own statement.

Classification of Races

The popular classification of races today is based on skin color, which gives five main groups: black, brown, red, yellow, and white. These separate groups are then to be divided into other groups. Thus we speak of the Teuton, the Slav, the Latin, etc., as separate members of the white group. It is frequently supposed, furthermore, that these different groups are but distantly related.

A very different view of the question of race differences and of racial composition is put forth by Dixon. He disregards the differences in skin color and bases his classification primarily on measurements of the head. On this basis he arrives at a division of mankind into eight primary groups or races. The characteristics of these eight primary types are presented in Table II (page 278).

Archæological and other evidence indicates that man appeared on the earth several hundred thousand years ago. According to Dixon, the evolution from pre-human anthropoid forms into man probably occurred at different times and at different places, and these eight fundamental human types may represent as many distinct transitions from pre-human to human forms. Since the appearance of these

TABLE II

CHARACTERS OF THE EIGHT PRIMARY TYPES OF MEN
After Dixon, *The Racial History of Man* (1923, p. 500)

Types	Head	Face	Nose	Prognathism	Capacity
Proto-Australoid	Long low	Medium broad	Broad	Moderate	Small
Proto-Negroid	Long high	Medium broad	Broad	Moderate	Small
Mediterranean	Long low	Narrow	Narrow	None	Large
Caspian	Long high	Narrow	Narrow	None	Large
Mongoloid	Round low	Broad	Broad	Moderate	Medium
Palæ-Alpine	Round high	Broad	Broad	Moderate	Medium
Ural	Round low	Medium	Narrow	None	(Largest)
Alpine	Round high	Medium	Narrow	None	Largest

distinct types more than a hundred thousand years ago, there have been many migrations of races from one part of the world to another and as a result of these migrations the primitive types of races have mixed in varying proportions to form the races of today, with none of our present races representing pure original types. The Indian population of North America is thus thought of as being due to successive waves of immigration from Asia bringing at different times perhaps different primary racial types. It thus happens that the American Indians are not a homogeneous people of the same fundamental racial composition, but rather that in different parts of the two Americas we find very different kinds of Indians. In some places they are mostly of Alpine or of Ural type, in other places mostly of Proto-Australoid or Proto-Negroid type, in other places mostly of Caspian and Mediterranean type, etc.

In a similar way, in Africa we find various types of

Negroes. Some are predominantly Proto-Australoid and Proto-Negroid with little or no mixture of other racial types, while others show a considerable mixture of Mongoloid, Palæ-Alpine, and other racial types.

When such a method of analysis is used in comparing the yellow and the white races, it develops that both races are in large measure due to the same fundamental race types but that both races have subdivisions of rather different compositions. From this it might follow that some white groups are more like some yellow groups than these same white groups are like some other white groups.

Just as the white and other races when classified by color are subject to analysis into fundamental types with the result that many and varied combinations are found, so it results that the populations of particular countries, as France, England, Germany, Italy, are not homogeneous but may be analyzed into different groups in some of which Alpine elements predominate, in others Mediterranean elements, in others Caspian elements, etc. In France then, for example, we find today groups largely of Alpine or other primary type which are much like groups found in England, Spain, Italy, or Germany.

The present writer is not an anthropologist and is, therefore, not qualified to pass judgment on the accuracy of Dixon's conclusions. In view, however, of the known migrations and race mixtures which have occurred during the past three thousand years, it seems extremely probable that the races now so different in skin color may have more common ancestral elements than is generally supposed. As a basis for the interpretation of mental differences due to race, the view as set forth by Dixon or one involving similar ideas as to migrations and racial mixtures over a long period of time would seem most satisfactory. If acceptance of such conclusions has no other merit, it will at least suggest the danger of drawing conclusions of too

sweeping a character regarding the average mentality of a people of a particular color, race, or nationality on the basis of small samples of that population selected from one locality. There is excellent reason for believing that one skin color, one race, one nationality may include peoples of very diverse mental capacities and characteristics.

Physical Differences between Races

In examining the question as to the nature and extent of race differences in mentality we shall follow our general practice of noting first any important physical differences. The differences in color have already been noted. In some way during the process of racial evolution distinctions in the pigmentation of the skin have been developed. And the pigmentation is hereditary. It is not due merely to immediate environmental action. With these distinctions in skin pigmentation have gone other and deeper differences, determined perhaps by the character of the primary races from which the group is descended. Because, however, of the complexity and diversity of the races when classified by skin color, it becomes an almost equally complex task to describe the other physical characteristics. We may say that the African Negro has a low, broad nose, thick lips, kinky hair, and a low, long head; but on examination we find that not all Africans are alike in these characteristics. The Negroes familiar to Americans are not typical of all black peoples. Or again we may say that Anglo-Saxons are tall and that Chinese are short, but some Chinese groups are tall and some Anglo-Saxon groups are not. As long, therefore, as we follow the prevailing classification of races by color, any statements made regarding anatomical characteristics must be understood to apply only to members of the group supposed to be most typical. Other groups of the same skin color may be

different in other physical traits. This is undoubtedly true of head form, shape of nose, stature, and in all probability applies quite as well to other traits both physical and mental.

Strictly comparable studies of the nervous systems of different races have not been made. In order to make a really reliable comparison of racial differences it would be necessary to examine a large number of unselected brains and this is practically impossible. In China there has been until recently such hostility against dissection of the human body that such a study would have been impossible. It is practically so today. It has not been possible to study either the brown race or the red race to any great extent.

In American laboratories some comparisons have been made of the differences between the whites and the blacks, but these have led to no certain conclusions. Also the problem is made more difficult on account of race mixture, and in such cases as are studied it is at times impossible to be sure of the racial heredity of the Negroes studied. Finally, the common enemy of statistical studies, the fallacy of unfair selection, enters into such comparisons, because brains are usually taken only from unclaimed bodies and the whites whose bodies are unclaimed probably represent a relatively inferior sample of the total white population in comparison with the sample obtained of the Negro population.

The only difference between the brains of whites and blacks of which we have reasonably satisfactory evidence is a difference in the weight of the cerebrum. In whites this averages about 1,200 grams and in Negroes it is about 100 grams lighter.

There appears to be a difference between whites and blacks in resistance to cold and also in resistance to certain diseases, notably tuberculosis.

On the whole, the evidence of differences in anatomy and physiology is not sufficient in itself to enable us to make any direct deductions as to probable mental differences, unless we accept the difference in the weight of the cerebrum as being a reliable indication of differences in intelligence.

If in the confession of our ignorance of exact quantitative differences in detailed physical characteristics we seem to arrive at no conclusion, there remains an argument of the first importance which may be based on recognized differences. According to prevailing scientific conceptions, mind, no less than body structures and functions, is a product of evolutionary forces. It is associated with body structures and functions and is inherited in the same way. If, then, the bodies of different races have developed, as we know to be the fact, along somewhat different lines, why not also the minds of these same races? Is it reasonable that the minds of all races have developed alike when their bodies have developed differently? On the face of things, such a result would be contrary to our understanding of fundamental biological principles. Since marked anatomical differences exist, it appears probable that mental differences also exist. A further *a priori* argument for the existence of mental differences can be advanced on the basis of the selective influence of the environment. The progress of evolution, though conditioned probably primarily by inner factors causing variation, has been dependent on the selective influence of the environment. The darker races, black and brown, appear to have been a tropical people to a far greater degree than the white race. Life in the tropics is essentially different from life in the colder climates. Food is more plentiful and easier to get; less intelligence is necessary in order to survive; and as the hot climate does not favor great activity it seems probable that individuals who are too active and industrious

would not be so likely to survive as those who are more phlegmatic. In a colder climate conditions would be reversed and greater intelligence in the making of clothing and shelters and in the providing of food would have been necessary; hence more low-grade individuals would have been eliminated. Whether the environment has actually operated in such a differential way and has produced such results is a question of fact to be determined by suitable tests, but *a priori* it seems probable that differences in mental traits would have developed.

The Historical Achievements of Races

Our knowledge of the histories of the different races is limited to relatively recent times. The red race was unknown to Europeans before the discovery of America, and the Indians did not have very ancient records. The same holds of the brown race. The yellow race has old records, but they are not so satisfactory as those of the white race. Except where the black race has come into contact with the white race, little is known of its early history. Any comparison of racial histories must therefore, be limited to relatively recent times, *i.e.*, about three thousand years.

According to biologists and anthropologists the birthplace of the human race, *i.e.*, the place where differentiation of human characteristics from the pre-human anthropoid characteristics occurred, is variously placed, as in Africa, in the table lands of Asia, or in the belt extending from England across Southern Europe and Asia to Java. Several races may, as Dixon supposes, have originated at different places.

The Proto-Negroid and Proto-Australoid types probably developed in the southern part of Asia, or perhaps farther north when the climate of the northern hemisphere was hotter than now. From them the present brown and black

races are supposed to be for the most part descended. They have remained in the hotter climates, the brown race moving into the islands of the South Pacific and the black race migrating to Africa.

Until relatively recently the brown races have been but little influenced by contact with other races, while some at least of the black races have been for a long period of time in contact with the whites. In neither case, however, has any considerable degree of civilization been developed. Both races when left alone have remained on a low level and have developed neither literature, science, nor arts to any great degree. Their religion has been of the crudest and most primitive type. When allowed to profit by contact with the white man they have done no more than necessity required. If a tree is to be judged by its fruit, if the intelligence of a race bears any relation to its accomplishment—even with the most liberal allowances for circumstances—it seems difficult to draw any conclusion other than that the black and brown races are inferior to the white race.

When and how the Indians reached America is unknown. The great variation in the physical characteristics of different tribes suggests that they represent rather different ancestral origins. Other evidence also supports the view that successive waves of immigration have entered the country. To some degree these different groups have amalgamated, but great differences remain. Some tribes have physical characteristics much like some of the black and brown races, others are more like some of the white races. In degree of civilization there were great differences ranging from the relatively high development of tribes in Mexico and Central America downwards to a very low barbarism.

When the white man appeared, the Indians fought him, and as a result they have been all but exterminated. This

may be interpreted as being due to a lack of intelligence: a more plausible interpretation is that it was due fundamentally to emotional and instinctive differences. The Indian was essentially a fighter, and he fought to the last regardless of the consequences.

If the yellow race began in the belt extending from England to Java, it has migrated northward and eastward so as to cover the greater part of the continent of Asia. If we accept the hypothesis that the dark skin pigmentation was developed in a hot climate, this would indicate that the Chinese must have spent a long period in Southern Asia and that the northern migration has been more recent.

When we survey the historical accomplishments of the Chinese, we discover the fact that up to the beginning of modern European history the Chinese had made quite as much progress as Europeans had made. The compass, silk-worm culture, gunpowder, and printing are a few of the early inventions of the Chinese. Tastes differ, of course, and Occidental peoples may prefer their own art, literature, philosophy, and religion; but to the fair-minded student there can be no question that the early achievements of the Chinese have been of a very high order along those lines.

That the Chinese are at present not on the same level of economic and educational development as Western peoples cannot be denied, but that this shows any innate deficiency does not follow. Consider in this connection the feat of the Japanese, the cousins of the Chinese, who during the past three-quarters of a century have advanced from a condition of semi-barbarism to a level of economic and educational development higher doubtless than that of some European nations. If, then, the racial composition of the Chinese is much the same as that of Europeans, and if, furthermore, they have demonstrated in their early history as much ability and progressiveness as Europeans

demonstrated before the modern period, we may well ask why the Europeans on the one hand have advanced while the Chinese on the other hand have made but little progress. In order to solve this problem it seems necessary to survey certain details of European history.

During the Middle Ages, Europe was in every respect as unprogressive as China. China would, indeed have been preferable probably as a place of residence for one of a liberal and intellectual attitude of mind. Europe had no literature to speak of, because at the time very little of the ancient literature was known. Of science it had none and was resolutely opposed to discovering any. Of religion it had a little in the monasteries, and of government it had a variable and uncertain amount which rested in the hands of the strong. So bad were the conditions for a time that we refer to them as "The Dark Ages." Later it is true, the darkness dispelled somewhat and later still the light of the Renaissance broke through and at last the modern period of scientific discovery and economic development was ushered in. For this scientific and economic development the white race claims full credit and is sometimes disposed to offer this development as evidence of the intellectual superiority of the whites to other races. It is well, therefore, to examine the causes of the ending of the Middle Ages and the transition to and beginning of the modern period. Of these causes there are many, but we may consider very briefly a few of the more prominent ones.

The crusaders coming into contact with new peoples, new lands, new customs, and new ideas helped on their return to shake Europe from its attitude of conservative satisfaction with the *status quo*. At the same time the crusades stimulated commerce, especially on the Mediterranean; and with commerce go interchange of ideas, skepticism, and progress.

In 1493 the Turks captured Constantinople and overthrew the Eastern Roman Empire with the result that many scholars who had been there migrated westward and carried with them much ancient literature. This stimulated a revival of learning.

The invention of gunpowder (about 1250) resulted in the overthrow of chivalry and so in large measure in ending the mediæval system.

The discovery of the telescope (about 1611) opened new worlds and made possible the verification of the Copernican theory of astronomy. This had a profound effect on the attitude of the learned world towards the dogmatism of the Church.

The invention of the mariner's compass (about 1250) led to geographical exploration including the discovery of America and the circumnavigation of the globe. The stimulus of this series of discoveries to further discoveries and expansion must have been very great. We of today can hardly appreciate the effect of such a discovery on the people of the fifteenth century.

The invention of printing (1423) made possible the reproduction of books and so made possible more extensive education of the masses.

In philosophy a reaction had set in against dogmatism, against faith in Aristotle as an infallible scientist, and from this resulted an interest in free inquiry and free investigation. This movement in philosophy was stimulated and encouraged by the various influences already mentioned, and the total effect of these was a breaking away from the narrow dogmas and conservatism of the time.

The religious revolt against the authority of the Church as illustrated by the Reformation and the civil revolt against the same authority with the resulting development of independent states made it possible for scientific development to take place. It is safe to say that, had the Church re-

mained in control, the scientific advance could not have been made and without that we should still be living under the religious, educational, political, and economic restrictions of the Middle Ages. Chinese civilization and Western European civilization would in that case not be so greatly different with respect to level of development.

That China has fallen behind while Europe has been advancing religiously, educationally, politically, and economically will be admitted without question by most people, including the educated Chinese. Why has this been true? In the first place, China has not had the stimulating contacts that Europe has had. Early travel was much easier by water and Western Europe was blessed by the presence of the Mediterranean, the middle-of-the-world sea. This facilitated invasions, conquest, race amalgamations, commerce, travel, and dissemination of knowledge. The peoples of Europe started their rise from barbarism on the shores of the Mediterranean. China had no such sea. At present we are not in position to estimate just how much this accident of geographical environment has meant to the white race, but clearly it has meant much.

In addition to geographical isolation the unprogressiveness of the Chinese appears to the writer to be due to two causes: language difficulties and ancestor worship. The Chinese language is of such a character that it requires vastly more time and effort to learn to read it than is required to learn to read most European languages. This has been greatly responsible for keeping the Chinese population illiterate, and illiteracy obstructs all kinds of progress. Ancestor worship has placed a premium on the past and has caused departures from the ways of the ancestors to be considered impious. This has resulted in the development of customs and traditions of inflexible character and these have been an effective bar to the introduction of new methods of thinking and doing and to new ideas. There is

no good reason to believe that the Chinese would in the absence of these more or less accidental difficulties have remained so long on the low level of development which characterizes them today in the scientific and economic fields. Morally they compare favorably with Europeans, although their codes are somewhat different.

Achievements of Different Races in Higher Education

It is rather a significant fact that most of the higher institutions of learning are owned, operated, and supplied with teachers and students by the white race. The black, brown, and red races have little to offer in comparison. Rapid strides are, however, being made in China and especially in Japan in the direction of establishing higher educational institutions. These give promise to compare very favorably with our own.

Another interesting though not a conclusive comparison of the mental capacity of different races may be made by comparing the work done in American colleges and universities. In our larger institutions practically all races are represented. The representatives are, of course, not average samples of the populations from which they come; but it is, nevertheless, useful to note in a general way the results of such a comparison.

Full-blooded Negroes are rarely met with in our graduate schools. Those classed as Negroes are usually mulattoes. Even disregarding this fact, it is undeniable that the work of the Negroes is much inferior to that of the whites. They have not demonstrated the capacity to do the grade of scientific work done by the whites. No Negro has attained first rank as a scientist.

Members of the brown race are rarely met with in graduate schools and they have not demonstrated any exceptional ability to do scientific work.

Indians have often done good college work, but the full-

blooded Indian does not show interest in advanced work. This is partly influenced, the writer believes, by differences in emotional make-up. Differences in environmental pressure must also be partly responsible.

Only the yellow races have demonstrated ability and interest in higher education equal to that of the whites. The Chinese and Japanese students sent to this country have often demonstrated an exceptional order of ability and on the basis of their work there is no reason for considering them in any way inferior to the whites. Higher education of the Japanese and Chinese is still too recent to enable us to see the full effects of their training.

Race Differences Shown by Tests

Strictly accurate and comparable results of the measurement of the mental capacity of different races can hardly be said to be available at present. Many measurements have, indeed, been made; but these have been obtained under varying conditions and by the use of different tests. A further and an even more serious difficulty arises from the probability that when races are classified by color each race will be found to be composed of many sub-groups of different mental capacities. Even when a large number of cases is examined, it is, therefore, unsafe to generalize on the average mental level of the race until there is more information than is at present available as to variations within the race. In considering the available experimental results, this caution should be borne constantly in mind. A few years ago professional psychologists would have scouted the idea of the possibility of the existence of such variation within a population as has been demonstrated by recent tests.

From the results of the Army tests given during the World War, a comparison of the whites and the blacks may be made. In view of the numbers of cases involved and

the probability that the groups used represent about as nearly a fair sample of the respective populations as it is possible to get, these results are of very great value. In terms of the Stanford Revision of the Binet-Simon Tests the Negroes were found to have an average mental age of 10.37 years and the whites to have an average mental age of 13.08 years. This gives a difference of 2.71 years in favor

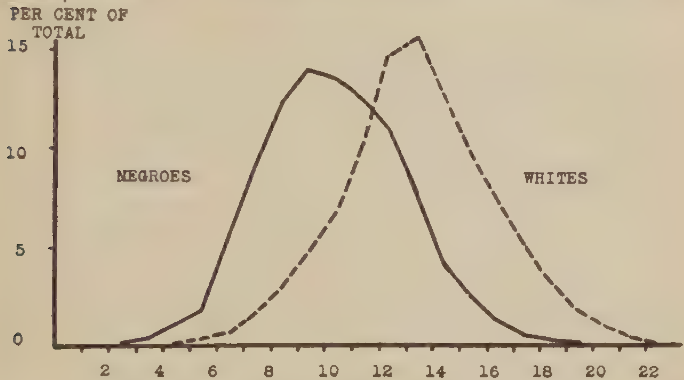

FIG. 39.—DISTRIBUTIONS OF THE SCORES MADE BY WHITES AND NEGROES ON THE COMBINED SCALE OF THE ARMY TESTS.

The horizontal scale shows the mental ages in years in terms of the combined scale. The vertical scale shows the per cents of the total. (Based on data from Brigham, 1922, p. 80.)

of the whites. After the most rigorous criticism there is no good reason for doubting that this represents a real and an important difference, though the exact figures given need not be taken as precisely accurate. Various comparisons show that the differences found cannot be explained by differences in education. They represent real differences in mental ability. The conclusion based on the Army tests is supported by numerous other investigations.

The results of the various tests enable us to say with confidence that the average Negro is inferior in intelligence

to the average white. The difference is less in sensory and motor capacities than in the higher and more abstract thinking processes. Also the difference between young Negro children and young white children is less than the difference between adults. Negroes mature earlier and do not reach so high a level. The educational possibilities of the Negro are, therefore, considerably less than those of the whites.

The mulattoes, or Negroes with a mixture of white blood, are in general found between the two races. Some of these mulattoes with intelligent white ancestors show marked intellectual ability. The leaders among the Negroes usually belong to this group.

No comprehensive data with reference to the brown race are available, and due to the relatively uncivilized condition of a large part of the brown people it seems probable that it will be a long time before much of value will be obtained. Of the group the Hawaiians are probably the most intelligent.

Studies of several tribes of North American Indians have been made. The general result of these studies shows that the Indians are less intelligent than the whites and that in those of mixed blood there is a relatively high correlation between the amount of white blood and intelligence. Some of the Indians are less susceptible to fatigue than are the whites. A definite statement of the amount of difference between the average white and the average Indian cannot safely be made.

A number of measurements of Chinese and Japanese children have been made in China, Japan, Hawaii, and especially in California. These have usually shown a somewhat lower score for the yellow groups, but the difference has not been a great one. The numbers have not been very great and no certainty exists that the cases studied represent an average sample of the population. In

view of the language difficulties usually encountered by foreigners and their children, there is further reason for being cautious in drawing conclusions. With these considerations in mind the writer inclines to the view that nothing in the test results shows the yellow race to be inferior to the whites. Somewhat opposed to this conclusion is the view of Garth, who, after reviewing the recent literature on race differences, concludes:

> These studies taken all together seem to indicate the mental superiority of the white race. There may be some question, however, about the indicated intellectual inferiority of the yellow races. Altogether, it may be said that the investigators recognize that these experimental results are crude and so must be taken tentatively. Nevertheless they and similar studies have real value, since they are the beginnings of the application of scientific method to the problem of racial psychology.[1]

The Intelligence of Different White Races

The United States Army during the World War included soldiers from most nationalities. The scores on the Army intelligence tests for these various groups have been studied by several investigators, especially Brigham. In brief the results of these studies show that the immigrants from Northern and Western Europe make better scores than those from Southern and Eastern Europe. English, Dutch, Scotch, Germans, and Danes are at the top of the list with Irish, Greeks, Poles, Russians, and Italians at the bottom of the list. The difference between the English and the Italians is a large one, 3.86 years. But is this an accurate measure of the difference between the average Englishman and the average Italian? Hardly. All that it tells us is that the average of our *immigrants* from Italy has been distinctly lower in recent years than the average of our *immigrants* from England. What the relation of these

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[1] T. R. Garth, "A Review of Racial Psychology," *Psychological Bulletin,* Vol. 22, p. 359.

respective averages is to the general averages of their countries is not indicated in any way. It has been more than once reported that some of the European nations have used our shores as a dumping ground for their undesirable citizens, and if such were true, or if any other cause operated to give the same result, it would naturally follow that the sample of the population available for study in America would give little indication of the average ability of the parent country. For such reasons the writer is unwilling to use Brigham's results as a basis for drawing conclusions as to the comparative intelligence of European races.

Under existing conditions a study of the actual accomplishments of the different European races is probably a much better guide to follow in estimating their intelligence than are any experimental data at present available. Experimental study is the ideal to aim at, but to make results comparable a considerable amount of international coöperation would be necessary. Further study is greatly needed to show the distribution of the intelligence of the various nations, for this is of more practical importance than is the average intelligence. To each nation the question of the geographical distribution of the different grades of intelligence is also very important. Not all districts can reasonably be expected to have the same average intelligence. The situation in this respect in the United States will be discussed in a later chapter. Further studies of racial differences will perhaps be more profitable if instead of studying general intelligence we have a comparison of races in specific abilities. There is good reason to believe that even the so-called inferior races may be superior to the more intelligent ones in certain respects.

Race Mixtures

Race mixtures are frequently due largely to the lower part of each race. If such is the case the hybrid is naturally

at a disadvantage. Considerable opposition to race crosses is due to the failure to recognize this fact. Speaking purely from a biological viewpoint, race mixtures would in certain ways be beneficial in that they would make for greater variation through bringing together new genetic combinations. Dixon holds that such a factor was the most important cause of the brilliancy of ancient Greece. At the same time, the crossing might well mean bringing together all of the worst traits of certain races in some individuals and these would present a serious problem. The greater the difference between the races, the more likely this last result is to follow.

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CHAPTER XII

EXTREME DEVIATIONS IN MENTAL TRAITS: I. SUPERIORITY AND GENIUS

The Meaning of Genius

In earlier times the leaders and prophets of a people have often been supposed to have been set apart from ordinary men by the possession of some special gift, divine inspiration, or power. It is not so long since European kings claimed a "divine" power, and even with the passing of that idea the view still lingered that men of genius were in a separate and distinct group as compared with ordinary men.

The modern conception of genius may be said to date from the publication of Galton's *Hereditary Genius* in 1869. This study showed that genius is inherited and that the traits of the genius are of the same kind as those of other men only that in the genius a much greater degree of ability is found. The difference, then, between normality and genius is one of degree and not of kind. On this basis any person may be said to be a genius if he shows abilities vastly superior to those of the average citizen. The person with exceptional musical ability is a musical genius, the person with unusual mathematical ability is a mathematical genius, and the person with rare military ability is a military genius. In short, there are as many possible kinds of genius as there are kinds of mental abilities in which people may vary to a sufficient extent above the normal to deserve such a title. The exact extent to which one must deviate from the normal in order to be considered a genius

is, however, in part dependent on environmental conditions. As a rule only one or a very few of the leaders in a particular field of activity will at any particular time be classed as geniuses. In the present discussion we shall consider genius primarily as an extreme deviation and only secondarily in relation to reputation.

Studies of Genius

The work of Galton, already mentioned, deserves first place in a list of the literature on genius. Galton studied 977 eminent men and their relatives. Each of these was of such a degree of eminence as to be the most gifted individual in a group of 4,000. The work of Woods on royalty probably also deserves to be listed here. Woods studied the mental and moral inheritance of 671 members of royal families. Many at least of these deserve to be rated as very superior. Havelock Ellis studied 1,030 British men and women of genius. American men of science and other eminent men have been studied by Cattell, and the data on American men of science have been further analyzed by Brimhall. Other studies have been made by Clarke, de Candolle, and Odin. There are, of course, numerous additional studies of individual cases of genius.

With the development of mental tests psychologists and educators have discovered that not only do we have average people and people of genius but that we also have all grades of ability between these. There is an increasing realization of the social importance of the superior child and an increasing tendency to show the same degree of concern about the superior child that has been shown for some time about the defective child. As a result there have been many recent studies of superior children. High-school seniors have been surveyed by Book, by Deich and Jones, and by Colvin and MacPhail. Many high-school seniors, of course, are not greatly above the average, but the group

as a whole is sufficiently superior to deserve some consideration here.

The most valuable study to date on school children has been made by Terman with a number of associates. A group of 643 children selected mostly from grades 3 to 8 inclusive and 309 high-school pupils have been studied in some detail. These have been selected from the schools of California cities so that they represent approximately the brightest 0.5 per cent of the population of the ages studied. Most of them have I.Q.'s of 140 or above. The careers of these pupils are being followed and in the course of a generation this and related studies should supply information of inestimable value on the subject of genius.

The Antecedents of Genius

Ancestry.—The character of the ancestry of men of genius may be determined in a general way by considering their social class. The ancestry of 96 English men of science studied by Galton was as follows:

Nobility and gentlemen	9	
Military and government	18	
Professional	34	
Commerce	43	
Farmers	2	
Others	1	
Total	107	(11 duplicates)

The ancestry of the eminent men and women studied by Havelock Ellis was as follows:

	Per Cent
Professions	35.2
Upper classes, officials, army, navy	27.8
Commercial	18.8
Crafts, artisans, unskilled	11.7
Yeomen and farmers	6.0

Cattell's study of American men of science showed their fathers to be of the following classes:

	Per Cent	
Professional	43.1	(3.0 per cent in general population)
Commercial	35.7	(34.1 " " " " ")
Agriculture	21.2	(41.1 " " " " ")

Terman's group of school children had fathers from the following groups:

	Per Cent
Professional	31.4
Semi-professional and business	50.0
Skilled labor	11.8
Semi-skilled to slightly skilled	6.6
Common labor	0.13

Comparison with the general population shows that the professional group supplies from 8 to 10 times its quota of superior and distinguished individuals. Relatively few come from the ranks of common labor.

From the above statistics regarding the social class and occupations of the parents of distinguished men we should naturally expect to find their economic position to be somewhat better than the average. There would, however, naturally be a lower economic than intellectual position, because the professions do not as a rule become wealthy. The modal income for the parents of the children studied by Terman is about $2,000; and the median income is $3,333.

The education of the parents of superior individuals is distinctly superior as indicated by Terman's results. The grandparents of the children studied had a median school training of 8.9 years. The parents had a median schooling of 12.1 years. Roughly, then, the grandparents had finished the ninth grade and the parents had finished high school or the equivalent. These figures are probably double the

averages for their respective generations. The present average for the adult population at large is probably somewhat less than 7 years. The Army test records showed an average schooling of 6.9 years, which is undoubtedly higher than for the older part of the population. In 26.4 per cent of Terman's cases, one or both parents were college graduates. In the general population probably less than 1 per cent are college graduates.

Of more interest in relation to superiority and genius is the number of eminent relatives. Galton's study showed that his 977 eminent men had of as great a degree of eminence as themselves 50 grandfathers, 94 fathers, 54 uncles, 123 brothers, 66 nephews, 145 sons, and 42 grandsons, a total of 574 eminent relatives within such a degree of relationship, and with a total of 739 cases of all degrees of relationship of which there were accurate records. About two-thirds of these, exclusive of fathers, brothers, and sons, were on the male side and about one-third were on the female side. In case of great divines the proportions were reversed.

Terman did not determine the exact number of eminent relatives of the children he studied. He did find, however, an unusually large number of cases of eminence as a result of an incomplete study. Brimhall in his study of the relatives of American men of science also secured results similar to Galton's.

Since Lombroso popularized the idea that genius and insanity are closely related, some rather extreme claims have been made to the effect that genius is impossible without some degree of insanity. It is, therefore, interesting to examine the actual figures. Havelock Ellis says: "Less than two per cent of our eminent persons are stated to have had either insane parents or insane children." He further points out that genius of the highest order is less likely to be associated with insanity than is genius of a

lower order. In Terman's study, 0.3 per cent of the grandparents and 0.4 per cent of the parents of the group were insane. A total of 57 cases of insanity were found among the relatives, but 36.8 per cent of the cases were found in the relatives of 1.6 per cent of the families, which shows that it was rather concentrated in the families where it did occur and that nearly all of the families were free from it. Under such conditions it is clearly unsound to hold that there is any constant or necessary connection between genius and insanity. Another phase of the matter which should not be overlooked is the percentage of genius found in hospitals for the insane. No person of experience and knowledge in the matter would seriously hold that the insane as a group show genius. At the same time it should be remembered that insanity and genius *may* occur together.

Another view of genius which is often held is stated by Havelock Ellis as follows: "It is no paradox to say that the real affinity of genius is with congenital imbecility rather than with insanity." No figures, however, are submitted to prove this statement. Terman's results show only 15 cases of mental deficiency in the families of the superior group of children and 5 of these were in the family of one parent. None of the parents was himself feeble-minded. The necessary conclusion from this is that as a class the near relatives of these superior children showed much less mental defect than is found in the average of the population. The fact that such a large majority was entirely free from such defects is sufficient proof of the falsity of the common view of the relation of genius to mental abnormalities.

Other characteristics of parents which appear to be of some possible significance are their greater energy and longevity. The superior energy of the parents is emphasized particularly in Galton's study of English men of

science. It is to be expected that greater energy would in general be associated with greater longevity, though just how much difference there is in this respect cannot be stated.

The average number of children in the families which included the men and women of genius studied by Havelock Ellis was reported as 6.5 in comparison with 4.5 for the general population. Galton stated the corresponding figure for the English men of science to be 6.3. This difference is due, in part at least, to a statistical fallacy which will be explained later. Havelock Ellis also points out that the interval between births is less in the families producing eminent men. If, however, we were to accept the statement that the families are larger, we should expect the intervals between births to be less, because this is the general tendency in large families.

Redfield has for some years attempted to establish the view that mental capacity depends on the age of the parents at the time of the birth of the child. Youthful parents were supposed to have children inferior to the children of older parents. Unfortunately the statistics on this subject are complicated by the differences in the ages at which different classes in society marry. As a rule the lower classes marry somewhat earlier and so have their children earlier. But this has no necessary connection with ability. The fathers of the men and women of genius studied by H. Ellis had an average age of 30 years at the time of their marriage. The average age of the fathers at the time of the birth of the superior children was 37.1 years. The average age of the fathers of Terman's group was 33.63 years at the time of the birth of the superior children. For the English men of science (Galton) the corresponding figure is 36 years. For the American men of science (Cattell) the figure is 35 years. In point of fact we find the ages of fathers and of mothers rather widely scattered.

In the group studied by Ellis the fathers ranged in age from 16 to 79. A similar distribution of ages is reported by Terman. There is, therefore, no basis here for such an assumption as Redfield has made.

Order of Birth.—If Redfield's guess were correct we should expect to find that the youngest child in a family is more likely to be eminent than is any other member of the family. In point of fact we find more nearly the opposite. Havelock Ellis finds that the oldest child is most likely to become famous, that the youngest child is next in order of distinctive ability, and that children born in between have less chance of becoming distinguished. From his figures I have calculated the probabilities in families of 3 or more children to be in the ratio of 79 oldest children, 34 intermediate children, and 56 youngest children. The figures for the intermediate children have been determined by taking the average of all of the positions between the first and the last. This makes the figures for the different positions comparable. Results by other investigators show a somewhat different relation. Using the same method of comparison, Cattell's study of American men of science shows a ratio of 214 oldest sons, 124 intermediate sons, and 124 youngest sons.

Terman's results on superior children have a relatively limited range as to family size, because of the method of selecting the cases studied. In spite of this, however, there is a surprisingly close agreement with Cattell's results in the percentages of superior children in the different birth ranks in families of 2, 3, and 4 children. This is a very important fact, because it shows that the superiority of the first-born is present in children to the same degree as in scientific men. From this it is clear that the influence causing this difference acts early.

The relation between the size of the family and the probability of great superiority is of interest in this con-

nection. The findings of Galton and H. Ellis to the effect that men of genius tend to come from large families have already been reported. However, Terman finds the correlation between the I.Q. of superior children and the size of the families of which they are members to be $-.271 \pm .062$. In view of the selected character of the group, such a correlation appears all the more significant. Furthermore, other studies have also led to the conclusion that there is a negative correlation between intelligence and size of family. We are thus confronted, apparently at least, with two contradictory conclusions as to the relation between family size and mental superiority.

How is this discrepancy to be explained? For one thing, the difference is based on a statistical fallacy. The numbers reported for average number of children per family by Havelock Ellis and others are misleading and the interpretation given them is not correct. The principle involved may be explained by reference to another illustration of the same fallacy. If one asks any large group of individuals selected at random or selected by any agency not specifically related to the factors studied to write down whether they are right-handed or left-handed and also write down the number of brothers and sisters they have, it will be found that the left-handed individuals have a higher average number of brothers and sisters than the right-handed individuals have, *i.e.*, left-handed people *seem* to come from larger families. The same thing should work for practically any relatively rare trait such as red hair. The reason is this: a rare trait, other things being equal, is naturally more likely to appear in a family of 12 children than in a family of 1 child. To be exact, it is just as likely to appear in 1 family of 12 children as it is to appear in 12 families of 1 child. In collecting statistics for family size, however, we do not make allowance for this fact. Instead of determining the average number of children per family

we should determine the per cent of the total number of children in families of different sizes who show red hair, left-handedness, genius, or any other relatively rare trait. On this basis there is good reason for believing that we should find a lower per cent of cases of genius from large families than from small families.

Why this negative relation between intelligence and family size? In part the difference may be due to differences in social and economic pressure which would cause superior families to limit voluntarily the number of children. In part it is possible that the mode of living followed by the intelligent classes has produced physiological differences which make them less capable of producing large families. American women of the upper classes have been unduly sheltered and restricted in the past, and there is good biological reason for holding that a life of ease and luxury tends to incapacitate for raising a large family. Considerable physical labor or exercise is necessary to keep the physical mechanism in order and when such exercise is lacking it is natural that decay in efficiency should result.

It is worth while to recall here the finding of Galton to the effect that a disproportionate number of English heiresses were sterile. They are, of course, the ones who might be expected to live in the greatest luxury. Statistics show that early marriages result in larger families, but the superior classes marry later. It seems probable, then, that the excessive number of superior children coming from small families may be due to a combination of several causes: late marriage, voluntary restriction in the size of the family, physical inefficiency on the part of the women, and excessive nerve strain. All of these would characterize the superior classes in contrast to the lower and middle classes where early marriage, absence of voluntary restriction, physical efficiency as a result of necessary labor,

and a tendency to take cares lightly would make for a greater fertility.

On somewhat the same basis it may be possible to explain the superiority of the oldest child. This superiority, it should be said, holds only for the smaller families. In Cattell's table, if we compare the number of distinguished men from the upper and lower halves of families of 7 to 12 children, we find that the upper half contributed 70 cases and the lower half 81. This is not a significant difference. The outstanding fact is, then, that in the smaller families the oldest child is superior. Can it be that this is due to a relative exhaustion of the mother in bearing and rearing the first child with the result that she is less able to produce a strong and energetic second or later child? Many women who have led reasonably active lives before the birth of a child become decidedly sedentary when they have a child to look after. Their physical condition is likely to suffer and it is possible that this may be a factor in causing relative inferiority of later children.

Contributory evidence for the above view is found in the fact that a disproportionate number of oldest children live to an extreme old age. It is also held that oldest children have smaller heads than later children, and according to Galton, *ceteris paribus,* men with smaller heads have more energy than men with larger heads, and great energy is necessary for success. It seems, therefore, not wholly improbable that the fundamental cause of the superiority of the oldest child in small families is physiological and that it is due fundamentally to the low physical efficiency of the mother which causes her to be excessively weakened by the birth and care of the first child with consequent injury to later ones. In very large families such a factor would ordinarily operate only slightly or not at all, because it seems fairly probable that the woman able to give birth to and raise ten children will be a woman of superior physical

energy and it is also probable that she will do more of her own work than is usually done by the mother of 1 or 2 children. While the unfit woman may have her health impaired or wrecked by one child, it does not follow that the fit woman will be at all injured thereby. That physical fitness may have a decisive effect on mentality will be shown in the next chapter in connection with the discussion of Mongolian imbecility, which, it may be said, appears to be due almost exclusively to exhaustion.

Such a view as the foregoing one must be accepted tentatively, if at all, until we have more conclusive evidence. And even if we do accept such a view, the fact will remain that ordinarily heredity is the really important determining cause of mental ability, because it is a fact that relatively, more only children are superior—this frequently in the face of the fact that the parents were unable to have a second child.

Condition of Mother during Pregnancy.—Terman's study included a question as to the condition of the mother's health during pregnancy. The answers to this for both elementary and high-school students indicate that in most cases health was better than average, but in a few cases health was reported as poor or very poor. In view of the uncertain meaning of such a classification, it is unsafe to draw conclusions. The fact, however, that in 80 per cent of the cases health was reported as better than average and in 8 per cent poorer than average appears to be of some significance. On the negative side it is perhaps important to recognize that apparent ill health in the mother is not incompatible with superiority in the child.

Conditions at Birth.—Terman's records of conditions at the birth of superior children show that in case of the elementary-school children instrumental delivery was necessary in case of 19 per cent of the boys and in case of 12 per cent of the girls. In the high-school group birth was

described as difficult for 55 per cent of the boys and 33 per cent of the girls. Such evidence seems to be more than sufficient to show that the common view regarding the effects of instrumental delivery in causing mental deficiency is not well founded. The brain is too immature at birth to be much affected by anything short of the most drastic mechanical injury. The reason for the unusual difficulties attending the birth of superior children is found in the fact that they are larger and so have larger heads. This is also the reason for more difficulty with boys than with girls. Hereditary mental deficiency is also frequently associated with large heads and in such cases instrumental delivery may be taken as the cause of the defect. The evidence is, however, almost entirely against such an explanation.

Sex Ratio in Families Including Superior Children

Havelock Ellis found that, in 180 families for which he had data, after excluding 29 cases where all the members of the family were boys the ratio between the sexes was 121 boys to 100 girls. However, in the families producing great women the ratio was reversed, there being 79 boys to 100 girls, all families of girls only being excluded. In 502 families of gifted children, Terman found the ratio between males and females to be 119.5 to 100. Since this included the families of both gifted boys and gifted girls, it does not agree with the result of Havelock Ellis for the families of eminent women. In this connection, a study of longevity showed that in 150 families selected for a tendency to long life the sex ratio was 116.2 to 100. This suggests that the excess of males is due to the greater energy of the family. Incidentally this agrees with the suggestion already made as to the cause of the relative excess of superior oldest children.

As a partial check on the studies just reported the writer has determined the sex ratios of the siblings of the fresh-

men entering Syracuse University in 1925 and 1926. The girls, 1,057 in number, had 1,183 brothers and 1,117 sisters, which gives a ratio of 105.91 boys to 100 girls. The boys, 1,374 in number, had 1,865 brothers and 1,811 sisters, which gives a ratio of 102.98 boys to 100 girls. Combining the two groups gives 3,048 boys and 2,928 girls, which gives a ratio of 104.10 to 100. This is approximately the same as that for the general population.

College freshmen are not, as a group, geniuses, yet it cannot be denied that they are superior. When, therefore, no difference in sex ratio is found for the families of college students, there is some ground for questioning the real meaning of the other results reported. It is at least possible that the sex ratios found by other investigators depend quite as much on the statistical methods followed as on differences in original data. For this reason the writer is unwilling without further evidence to accept the conclusion that there is any significant difference in sex ratio in the families from which geniuses and superior individuals in general come. In such studies, because of the treacherous nature of the selective factors which may be involved, results should be reported in detail, and a careful distinction should be made between the facts found and the interpretation of the facts and the conclusions drawn.

Sex Difference in Number of Superior Individuals

It is, of course, recognized that there are more *famous*—also infamous—men than women. Nor is it difficult to understand why that is the case. Women have, because of the biological differences between the sexes, already discussed in a previous chapter, certain physical handicaps and in addition certain social handicaps imposed by men which effectively limit the field of women's operations. Still more are they limited by differences in innate interests. Statistics as to the numbers of famous men and

women do not, therefore, answer the question as to the comparative intellectual abilities of the two.

Some evidence on this point is afforded by a comparison of the eminent relatives on the female side. Galton's study showed about half as many famous relatives on the mother's side as on the father's. This, of course, will be interpreted in different ways according to the bias of the reader.

In Terman's main experimental group the ratio between the superior boys and superior girls was found to be 121 to 100. In the high-school group the ratio was found to be 212.3 to 100. For I.Q.'s of 160 and above there is no significant difference between the sexes, although there is an excess of girls above 170 I.Q., as is shown by the following comparison:

	160 or above	170 or above	180 or above	190 or above
	Per cent	*Per cent*	*Per cent*	*Per cent*
Boys	18.5	6.2	2.6	0.0
Girls	16.5	7.2	2.0	1.0

In Book's study of the intelligence of high-school seniors we find that 5 per cent of the girls made a score of 163 or above.[1] Approximately 7 per cent of the boys made 163 or above. In absolute numbers this would be about equal to 186 girls and 173 boys. The reason for this difference between the absolute and percentile values is, of course, that there are about 50 per cent more girls than boys in the senior class. The actual figures are 2,477 boys and 3,711 girls. The boys are, therefore, a more selected group. Terman's group is, of course, more rigidly selected, but in view of the relative numbers of the sexes above I.Q.'s of 160 it is difficult to give a fully satisfactory interpretation

[1] W. F. Book, *The Intelligence of High School Seniors* (New York, Macmillan, 1922), p. 20.

of the facts. To the writer the most plausible interpretation of the difference between the results is that it is due to a difference in the character of the tests used. Evidently the Terman tests are somewhat easier relatively for boys. The fact that certain comparisons show the sexes to be about equal on the tests may be due simply to relatively greater maturity on the part of the girls at earlier ages.

The study of Deich and Jones of distinguished high-school pupils in Iowa resulted in the selection of 220 girls and 96 boys as the most brilliant students in their respective classes. Here the figures are as heavily weighted in favor of the girls as is Terman's study in favor of the boys. It is, therefore, difficult to escape the conclusion that the differences found reflect differences in methods quite as well as differences in the abilities of boys and girls.

Colvin and MacPhail in a study of seniors in the high schools of Massachusetts find that 42 per cent of the boys and 26 per cent of the girls are to be classed as good college risks. However, as there are 1,262 boys and 2,071 girls these percentages are equal to 530 boys and 538 girls. To give only the percentages would create the impression that the boys are superior to the girls, but when the absolute numbers are given it immediately appears that there is no significant sex difference.

From genetic considerations, as outlined in an earlier chapter, the writer is inclined to believe that a few more women will be found to have the highest grades of ability but that below that a slight excess of men will be found with no difference in the average level of mentality. In the nature of the case this is difficult to prove. However, the available data fit that view as well as any other.

Characteristics of the Superior

Physical Traits.—All scientific studies known to the writer are in agreement on the point that the average height

of superior men is above that of the general population. Studies of school children, on the other hand, have not agreed on this point. However, the matter would seem to be satisfactorily settled by Baldwin's study of the Terman group of superior children. He finds: "When age is made constant for the entire group of children from 2 years to 15 years of age by means of partial correlation, a small but probably significant positive correlation is found between mental age and height for boys and girls, but no correlation is found between mental age and other physical measurements."[2] There is great variability in height, and short as well as tall individuals are found to be very superior. The slight average superiority in height is most probably due to a greater activity of the anterior pituitary body. This influences the growth of the bones and apparently also the nervous system.

In other physical measurements the superior children are also somewhat above the usual norms, but there is little difference between normal and superior children in this respect. As stated above, Baldwin found no significant relation between intelligence and other measurements.

One of the peculiar findings in Terman's study is that "somewhat more than half of the entire group have undergone tonsillectomy. Only about a fourth of the remaining subjects have tonsils which are entirely normal."[3] Generally speaking the health of the superior group was found to be better than average.

Physical growth of the superior children was found to be faster than for the average. Dentition appeared to be slightly earlier. Walking averaged about 1 month earlier and talking about 3½ months earlier than the average. Sexual maturity was early, at least a year earlier than the

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[2] L. M. Terman, *et al., Genetic Studies of Genius,* Vol. 1 (1925), p. 171.

[3] *Op. cit.,* p. 249.

average. In all of these traits there was, of course, great variation. It is not possible to determine a child's I.Q. by finding out when he began to walk or to talk, though this is important contributory evidence.

Galton's study of famous divines caused him to conclude either that they as a group were physically weak or else that they had been wild in their youth. Aside from this exception we appear to be justified in saying that in general superior men and women appear on the average to be superior physically as well as mentally, but with many instances of inferior physique and superior mentality. The correlation between the two is at best relatively slight.

Intellectual Traits.—It is not possible to point out a group of general mental characteristics and say that these are the characteristics of genius. Rather it is necessary to deal with different kinds of genius. The requirements for great success as a singer, as a musical composer, as a sculptor, as a painter, as a poet, as a novelist, as a mathematician, as a biologist, as a statesman, as a soldier, and as a minister or priest are clearly not the same. Some of these lines of activity are probably even antagonistic. The critical attitude of the scientist is hardly calculated to make a great divine. The mathematician is unlikely to be a poet.

In a general way it seems probable that imagination and reasoning power are the most essential intellectual requirements of genius. No great amount of constructive imagination would seem to be necessary for the singer, however, and no great amount of reasoning power would seem to be necessary for any of the artistic class. This indicates the difficulty of a generalized statement. We shall not attempt it. Our only purpose here is to point out that genius is specialized and may exist in a high order in particular fields without great ability in other lines, though abilities of better than average grade may be expected even in unrelated lines. A group of children with special abilities studied by

Terman were found to have I.Q.'s of from 87 up, though most of these cases of special ability had I.Q.'s above 100. A large number of profile charts prepared for different superior children showed the same kind of irregularity in the strength of different traits as is found in normal children.

Social and Moral Traits.—Like intellectual characteristics, social and moral characteristics are by no means uniform in degree of development in eminent men and women. Scientific men are likely to be socially timid and retiring, though this could not be true of political leaders. Puritanism may be a trait of divines but is not so likely to be associated with military men or artists.

That eminent men are likely to be involved in social conflicts is shown by the fact that more than 16 per cent of the 975 men studied by Havelock Ellis had been imprisoned once or oftener, "while many others only escaped imprisonment by voluntary exile." It is hardly likely, however, that statistics limited to recent times would show any such result. Terman's results do not show that superior children are socially unusual or abnormal; rather they show that intellectually superior children are in general socially and morally superior also. It should be kept in mind that there is no *necessary* connection between intellectual superiority and social and moral superiority—there are cases of marked difference in the degree of development of these traits—but as a general tendency we do find that intellectual and social and moral superiority go together.

Insanity

We have already referred to insanity in the parents and relatives of superior individuals. Havelock Ellis finds 44 cases among his 1,030 men and women of genius. Of these 13 were unquestionably insane for a considerable part of their early or active lives, 19 were either only slightly insane

or insane for only a brief period, and 12 developed senile dementia in old age after long lives of strenuous intellectual activity. If we count all of the cases, the incidence of insanity becomes 4.2 per cent for the entire group studied. Certainly this percentage is not high enough to attempt as some have done to link genius and insanity as similar mental conditions. With reference to other nervous disorders, Ellis says:

> While, however, grave nervous diseases of definite type seem to be rare rather than common among the eminent persons with whom we are dealing, there is ample evidence to show that nervous symptoms of vaguer and more atypical character are extremely common. The prevalence of eccentricity I have already mentioned. That irritable condition of the nervous system which, in its Protean forms, is now commonly called neurasthenia, is evidently very widespread among them, and probably a large majority have been subject to it. Various definite forms of minor nervous derangement are also common.[4]

In calling attention to the nervous disturbances found in great men and women it should be recognized that such a characteristic in a great man is noticed and commented on because it happens to be a trait of a great man. On the other hand, we may see many, many nervous symptoms in people of lower social class and with no special distinction and under such conditions we are very likely to pass them by without special attention and speedily forget them. At the same time, it is reasonable to suppose that a great man would have a more sensitive nervous system and so would be more subject to nervous derangements than would an individual of lower mentality.

Heredity and Environment

We have already pointed out the fact that eminent men and women are from superior families. It might, of course,

[4] Havelock Ellis, *A Study of British Genius* (London, Hurst and Blackett, 1904), p. 197.

be urged that this is a proof that environment rather than heredity is the determining factor in the causation of greatness. Evidence against this is offered by Galton in the fact that the adopted sons of the Popes have not compared at all with the true sons of eminent men. Presumably they have had excellent opportunities, at least for eminence in the church, but they have not shown themselves able to profit by them.

It will hardly be maintained by any whose opinion is worthy of respect that a physical characteristic such as stature is determined by environment. Yet we find mental ability and mental greatness to show the same regularity in the relative amounts possessed by relatives. It seems necessary, therefore, to assume it to be hereditary. In so doing we are not overlooking the importance of environment. Obviously wars are necessary to bring out the qualities of a born military leader. Musical instruments are necessary for the success of the instrumentalist. A potential scientist would not have been successful in Europe in A.D. 700. Time and circumstance are extremely important factors in the success of a potentially great man; if the times are unfavorable the man may never be heard of. But time and circumstance can never do more than give the man an opportunity to show his qualities; it cannot supply the man with the qualities. This is the crucial point.

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CHAPTER XIII

EXTREME DEVIATIONS IN MENTAL TRAITS: II. MENTAL DEFICIENCY

Definition of Mental Deficiency

In the last chapter we considered one kind of extreme deviation in mental traits, great superiority. In the present case we are to consider the opposite kind of deviation, exceptional deficiency. It will save the student from certain common errors in thinking if this *contrast* in traits is kept clearly in mind. Both genius and deficiency should be thought of in relation to the normal distribution curve: they represent differences *in degree only* from the normal. Mental defectives are, then, people with the same kind of minds as those of other people but their minds are less efficient: they learn less readily, remember less, and reason with greater difficulty, and are only able to solve problems of less difficulty. There is no ground for considering defectives as belonging to a separate and distinct "type" of humanity.

From the foregoing it is evident that any line that may be used to divide the feeble-minded from the normal will be more or less arbitrary. We might, for example, agree that we would consider all people included in the lowest 10 per cent of the population as mental defectives, or we might accept some other figure, as 5 per cent or 20 per cent. Another method of defining feeble-mindedness would be to accept some particular test as a satisfactory test of normality and deficiency and then rate as defective all those making below a particular score on the test. This latter

procedure is the one that in practice has been most followed in recent years. When such a method is used, the percentage of mental deficiency will, of course, depend on the difficulty of the test.

After the development of the Binet tests and before the World War the rather general practice was to consider all adults with Binet mental ages of 12 years or less as mental defectives. As we have seen, however, the results of the Army tests were so surprisingly low that a marked downward revision in our ideas as to the average of mentality seemed necessary. To accept the 12-year limit for mental deficiency would, if we accept the results of the Army tests as valid, place nearly half of the white population and more than half of the Negro population in the class of mental defectives. It would seem much more plausible to accept some lower limit such as 9 or 10 years. There is, however, no general agreement as to what age should be used; but present opinion seems to be drifting towards the acceptance of the 10-year level, *i.e.*, all adults having Binet mental ages of less than 10 years are considered as feebleminded. In any case, the purely arbitrary character of this line of demarcation should be recognized.

In dealing with children it is necessary to use the intelligence quotient as the basis of determining relative mental deficiency. Different writers suggest different I.Q.'s as the upper limit of mental deficiency, but general agreement would place the dividing line at I.Q.'s of about 70 to 75. Pintner's suggestion that 14 years be considered the average adult mental age in terms of the Binet scale and that I.Q.'s of 70 and below be considered as defective seems the most satisfactory and defensible plan. This would make 9.8 years the dividing line between feeble-mindedness and normality for adults. At the present time, however, there is less disposition to base a judgment of mental deficiency solely on intelligence level. Careful workers also

attach considerable importance to emotional traits. Thus an adult able to pass an intelligence test with a mental age of 11 years but who is seriously defective emotionally may be adjudged a mental defective, while another adult with an intelligence level of only 9 years but with better emotional development and balance may not be considered mentally defective. This same principle naturally applies to the interpretation of the I.Q.'s of children.

Grades of Mental Deficiency

Morons, Imbeciles, and Idiots.—It has become customary to refer to high-grade mental defectives as morons, to middle-grade defectives as imbeciles, and to low-grade defectives as idiots. The same difficulties arise here as in the general division between normality and deficiency. The dividing line between these various grades is arbitrary and can only be fixed by general agreement, which does not at present exist. The older classification for adults as given by Goddard is as follows:

Idiots have Binet mental ages of.....1 to 2 years
Imbeciles have Binet mental ages of..3 to 7 years
Morons have Binet mental ages of...8 to 12 years

This classification might be retained if we changed the last group from 8-12 to 8-10.

In terms of the I.Q., Kuhlmann suggests the following classification:

Idiots have I.Q.'s of............... 0–24
Imbeciles have I.Q.'s of............25–49
Morons have I.Q.'s of..............50–74

When speaking in general terms such a classification will prove useful, but on the whole it will prove more satisfactory to give the I.Q. itself when speaking of particular children.

Idiots-Savants.—Most mental defectives show a reasonable amount of uniformity in the degree of development of different mental capacities. There are, however, certain marked exceptions to this general tendency. A few individuals are found who are markedly defective along nearly all lines except one, and in this one line they may be far superior to the average person. In the cases that have been reported, this exceptional superiority has usually been in some kind of arithmetical computation, or in ability to play a musical instrument, or in ability to paint, or do other artistic work. Less striking cases of the same variation will, of course, also be found. It may also be noted in passing that cases are often found of intelligent men who have a single marked defect.

Moral Imbeciles.—Mental deficiency is ordinarily understood to apply primarily to intellectual functions, though it is also generally recognized that intellectual defect is quite likely to involve moral defect. There are, however, some cases where no intellectual defect is present but where marked moral deficiency appears. Such cases are due to defective development of the instincts and emotions. In one such case tested by the writer an I.Q. of 120 was found, but there was a marked indifference to social criticism and equal lack of consideration for the rights of others. An interesting commentary on this case is the fact that the parents had on several occasions gone away on a vacation and had left the child behind without making any provision for her care and welfare. In this case, at least, the moral imbecility seemed hereditary.

There is, *a priori*, no particular reason why instinctive and emotional variations should not occur in the same manner as intellectual variations are known to occur, but due to our defective methods of measuring the emotions we have not yet reached the point where we can determine satisfactorily these emotional differences.

Traits of Mental Defectives

We shall now examine in somewhat greater detail the traits of mental defectives, following for this purpose the outline given in Chapter III.

Physical Traits.—The differences in size between high-grade mental defectives and normals are insignificant. The distributions for the two groups will almost coincide. Low-grade defectives, on the other hand, show a tendency to be smaller in size, though this is of small consequence.

In proportion mental defectives show more of a tendency to be short and stout than to be tall and thin. There is some reason for correlating this difference with inferiority of function of the anterior pituitary body.

There are no important differences in color of hair, skin, and eyes when we compare defectives and normals.

Inner physical differences are of more importance than outer ones. These are, however, more difficult to determine, and, on the whole, we know less about them.

According to our present understanding of the matter the most important inner structural differences to be looked for in mental defectives would be in the nervous system and in the glands of internal secretion. The nervous system has been extensively studied; but, due to the extreme difficulties to be overcome, very little more than a start has been made towards a full understanding of the differences in microscopical structure. Work on the glands of internal secretion has been very limited.

The available evidence shows that mental defectives tend to have fewer nerve cells, to have these less developed in size and in the number of ramifications of the dendrites and axones, to have the existing cells poorly oriented or arranged, and to have these defects relatively more prominent in the association areas than in the primary centers. In many cases of low-grade deficiency enough can be seen under the microscope to afford a sufficient explanation of

deficiency, but in the higher grades of defect we are not yet able to point out so definitely the anatomical basis. It is quite conceivable that the differences are chemical rather than anatomical.

In cases of hereditary mental deficiency it is not possible to point out really significant differences in the structure of the glands of internal secretion. Only in certain cases involving primarily particular glands is this possible. Hypertrophy of the anterior pituitary with resultant gigantism may result in mental deficiency. Also both under- and over-growth of the thyroid may be associated with insufficient function and so with deficiency.

Differences in the relative sizes of organs have been claimed for mental defectives, but the matter has not been very carefully investigated. Spitzka advanced the theory that the ratio between the weights of the cerebrum and cerebellum was correlated with intelligence. Spitzka considered the cerebellum an inferior organ and on that basis concluded that it must be relatively larger than the cerebrum in defectives. This was disproved by the writer who showed that the same variation occurs in men of genius as that found in mental defectives. There is, however, some reason for holding that the cerebrum and cerebellum combined have a smaller ratio to the brain stem or to body weight than in normals, but this difference is not a great one and there is much overlapping.

Doll finds a rather high correlation between the vital capacity and the intelligence of defectives. In part this is probably due to differences in ability to understand and follow instructions. It is not so strange, however, that lung capacity should be associated with intelligence when we consider the importance of oxygen to the system as a whole.

In health and resistance to disease mental defectives are much inferior to normals. They live shorter lives and this

is sufficient evidence of their inferior constitutions. This difference, like the others, varies with the different levels of intelligence.

In tests of strength and endurance it is difficult to determine accurately the power of defectives, because so much depends on ability to understand directions and on self-control in executing them. For this reason the showing of defectives is perhaps poorer than it should be. High-grade morons average about as well as normals in tests of strength with the dynamometer. Imbeciles are usually lower and idiots as a rule make a very poor showing.

There is a tendency for mental defectives to mature earlier, and this applies to both physical and mental growth. The absolute growth is, however, less. As a result of these two tendencies, the final degree of development tends to be less than for normals, and this is true to a marked degree at the lower end of the scale.

Psycho-Motor Traits.—Idiots and imbeciles often show marked irregularities in sensory capacity. Sometimes there will be an almost complete absence of a particular sense. Usually, however, we find only a slight degree of correlation between sensory capacity and mental development. Ability to discriminate two points usually correlates a little better than other sensory capacities with intelligence.

No reliable data are available on the subject of imagery in mental defectives. They are unable to give accurate accounts of introspection and there is no other satisfactory way to study images. By inference we would conclude that the imagery of defectives is somewhat inferior to normals and more inferior than is sensitivity.

The associational capacities and tendencies represent the field of greatest defect in feeble-mindedness. Associations are much slower and fewer in number. This has a marked effect on imagination and reasoning.

The same difficulty exists with respect to the affective

capacities as exists with respect to imagery. Reliable data would depend on introspection and that is not possible.

Idiots and imbeciles are more apathetic than are normals and so we are justified in saying that their emotions are less developed. In morons, however, there is no great difference as compared with normals, though the average intensity of the emotions is probably less. The greatest difference is found in the sympathetic and altruistic emotions which are the basis of moral conduct. These are phylogenetically late in development and they are, therefore, naturally most likely to be deficient in the underdeveloped individual. Goddard thinks that even the sex instinct and emotions are probably less developed in defectives than in normals. We should expect some other emotions to be even less developed.

Attention is based, in part, on interest, and as the interests of mental defectives are less varied and usually less intense, their powers of attention vary accordingly. The characteristics of attention in general would depend on mental age and so we should expect defectives to show about the same degree and control of attention as is found in normal children of the same mental age.

Perception is conditioned by past experience and to this extent older mental defectives may be somewhat more efficient in perceiving some things than are normal children of the same mental age, but otherwise there would be no great difference.

The memory of low-grade defectives is usually poor, the greatest difference being found in the ability to remember logical associations.

The outstanding and most significant defect of all grades of mental deficiency is found in reasoning. In the higher grades of mental defect especially there may be only slight differences in other processes and capacities and in some things the defective may even be above normal, but in

reasoning a greater defect will be found. This comes out to the greatest extent in dealing with abstractions. Defectives are often able to cope successfully with simple concrete problems when they are entirely unable to deal with abstractions. Algebra may be taken as representative of the kind of material most difficult for them to master.

It is fundamentally the defect in reasoning that accounts for some of the most important limitations in the vocabulary of mental defectives. When language is defined as "a system of verbal concepts" and concepts are understood to involve generalizations from experience, it is apparent that defect in reasoning ability will necessarily react on language. And when the concept relates to abstractions it is entirely beyond the mental defective; or, for that matter, it may be beyond any except superior individuals.

For the reasons just given we ordinarily expect to find that mental defectives are most deficient in what we have called abstract intelligence, though this is not necessarily true. They may be even more deficient in mechanical, social, or artistic abilities.

No significant differences are ordinarily found in the reflexes of defectives, though in the lowest grades there may be some differences. The strength of the instincts has already been referred to and the probability pointed out that in defectives they are somewhat weaker. Perverted instincts are often found, but this may be due in part to deficiencies in other directions.

The character of the acquired traits of defectives may be inferred from their native defects. Due to deficiencies in interest, attention, memory, and understanding, deficiencies in knowledge necessarily result. Low-grade defectives have but very little information.

Habits are acquired with greater difficulty by defectives, and skill in complex motor activities may or may not be

possible. In general, mental defectives are less efficient in this respect than are normals.

Ideals depend in large measure on the development of intelligence and emotions and it is, therefore, natural that mental defectives should have very low ideals. Their desires are usually rather close to the instinctive level and so their conduct is generally regulated by present conditions. They are conspicuously deficient in foresight and persistency of purpose towards anything far removed. This is to a considerable degree the basis of the moral shortcomings of the feeble-minded. In these respects defectives are often inferior to children of the same mental age.

Special Varieties of Mental Deficiency

In clinical practice it has been customary to group together certain varieties of feeble-mindedness which show certain common physical characteristics and which usually show some degree of uniformity in mental level. A few of the more common of these will be referred to here.

Cretins.—In Chapter II, in discussing the effect of deficiency in the thyroid gland, the essential characteristics of cretins have already been described. Whenever the thyroid is itself absent or defective, or whenever the food and water are deficient in iodine, the normal growth processes are checked. This affects especially the skeleton, the sex organs, and the nervous system. The result is that the child does not reach his normal mental level. If the deficiency is not too great he may almost reach it, but if it is very great he will remain an imbecile or idiot.

Cretinism is easily recognized by the physical symptoms. There is a tendency to stoutness, the legs are likely to be bowed, the hands and fingers are short and thick, the features are coarse, the skin is dry and wrinkled and sallow in color, and the hair shows a tendency to fall out.

Cretinism, if treated early enough during the normal

period of growth, can be cured, and these cases would consequently not be considered mental defectives, since by definition mental deficiency is commonly understood to be incurable. If, however, treatment is too long delayed permanent and incurable deficiency results.

Mongolian Imbeciles.—Mongolian imbeciles are so named because they have the characteristic Mongolian slant of the eye. They are further peculiar in that their final mental level is about 4 or 5 years. They have been for a long time one of the puzzles to students of mental deficiency, because they defied explanation. They appeared in families without any known hereditary taint and where there was no accident or disease that would afford an explanation. Statistical study of such cases, however, showed that a disproportionate number of them were born to women who were past 35 years of age. Few cases, relatively, were born to mothers in the twenties. Statistics further showed that such children were very often the last child born in the family and that the mother suffered something approaching exhaustion. This has led to the theory that Mongolian imbecility is due to endocrine exhaustion or at least to lack of endocrine balance. This would cause a disturbance of nutrition with resultant lack of development.

Hydrocephalics.—The ventricles in the brain and the cavities between the brain and the skull are normally filled by the cerebro-spinal fluid. In some cases, however, due either to improper elimination of the fluid or to its excessive production by the choroid plexus of the lateral ventricles, more than the normal amount accumulates and pressure on the brain and skull results. This is called *hydrocephalus* (commonly known as "water on the brain"). Sometimes this assumes the form of an internal hydrocephalus with the result that the ventricles are enormously dilated. In such cases, the pressure and the mechanical derangements of the parts of the brain result in serious mental impairment.

There are, of course, many degrees of this defect; we have been speaking of the more serious cases. In other cases the secretion does not so greatly affect the ventricles of the brain but causes a great increase in the size of the skull. If the skull increases in size sufficiently, there may be no important mental symptoms; but, if the increase does not relieve the brain of the pressure, an impairment of mental ability is probable. Permanent cures of such cases are rare, but some benefit may be derived from the periodic partial draining of the brain case. The cause of the production of the excess of fluid is not understood.

Microcephalics.—In rare instances cases are found with very small heads. The diameter of the skull may be but little more than half the normal. This involves, of course, a very small and undeveloped brain with corresponding mental capacity. *Microcephalics* are always of low mentality. However, not all cases with small brains have small skulls. Some have skulls of ordinary appearance but have either an excess of fluid or have very thick skulls or both. Nothing definite is known as to the causation of microcephaly. The most plausible guess at the present time would be some disturbance of nutrition caused by improper endocrine secretion, but as yet this would be only a guess.

Main Causes of Feeble-Mindedness

Some suggestions have already been made as to the cause of mental deficiency in particular kinds of cases. We shall now consider the causes of the larger group of cases which do not have peculiar physical characteristics.

Is feeble-mindedness a Mendelian unit character? In 1911 Davenport expressed the view that low mentality was due to the absence of some factor which, when present, caused the development of normal mentality. If, then, this factor was absent in both parents, it would naturally be absent from all their children and as a result all of their

children would be mentally defective. Davenport further assumed that if one of the determiners for normality was missing in each parent one-fourth of their children would be defective.

The foregoing is equivalent to saying that feeble-mindedness is a recessive Mendelian unit character.

In 1914, Thorndike commented on Davenport's view as follows:

> I fear, however, that the inheritance of imbecility will be found by no means so simple as Dr. Davenport hopes. . . .
>
> It seems probable that two imbecile parents produce widely varying offspring including some more imbecile than they and some far higher than they on the intellectual scale. . . .
>
> Mental traits are certainly not as a rule unit characters or the results, each from two or three coöperating unit characters. On the contrary, most of them seem to be the results of very many unit characters.[1]

In 1914 Goddard published the evidence collected from a study of the ancestry of a large number of mental defectives and concluded from this evidence that feeble-mindedness acts as a recessive Mendelian unit character, normality being the dominant.

Goddard's comments on reaching this conclusion are worthy of quoting at some length:

> That normal intelligence seems to be a unit character and transmitted in true Mendelian fashion is a conclusion that was forced upon us by the figures, and one that is difficult to make agree with previous conceptions. . . . Even now we are far from believing the case settled. The problem is too deep to be thus easily disposed of.
>
> Statistical theories and methods have a great value in modern science, but their application to the human problem is fraught with many and serious liabilities to error.
>
> The chapter "Is Feeble-Mindedness a Unit Character?" was written under the rather strong impression that feeble-mindedness

[1] E. L. Thorndike, *Educational Psychology*, 1914, Vol. 3, p. 265 *ff*.

is not a unit character. After the data were counted and seemed to show so conclusively that it is Mendelian we were inclined to omit the first part of the discussion on the unit character, but we decided to leave it, if for no other reason, to show the stages through which our thot had developed in the course of this study. The former view may yet be correct, but here are facts that cannot be ignored. . . .[2]

The writer confesses to being one of those psychologists who find it hard to accept the idea that the intelligence even *acts like a unit character*. But there seems to be no way to escape the conclusion from these figures.[3]

Although it is evident that Goddard stated this conclusion in a cautious and tentative way, various writers have accepted the statement as if it were conclusively demonstrated to be a fact. The present writer does not find the conclusion at all convincing and will, therefore, attempt to point a way of escape from the agreement of Goddard's figures with the theoretical expectation according to the Mendelian assumptions.

In statistical work the first requisite is accurate data with which to work. If the data are themselves open to serious criticism on the score of accuracy, it should be evident that any great accuracy in the results will be more or less accidental. Now it happens that in this particular study the institution children whose families were studied were themselves tested with the Binet test by a trained tester, and there is, therefore, no ground for serious objection to that part of the results. But the relatives of the children were not actually tested. Some of the relatives considered were dead. This is, of course, inevitable when an attempt is made to study the more remote ancestors. Whenever possible the living relatives were seen and talked with by a trained field worker. When it was not possible to see the

[2] H. H. Goddard, *Feeble-Mindedness, Its Causes and Consequences,* (New York, Macmillan, 1914) p. ix.

[3] *Ibid.*, p. 556.

individual, or when he was dead, dependence had to be placed on such reports of his behavior and characteristics as were available. This would work fairly well for low-grade cases of feeble-mindedness, but as Goddard points out it is open to objection when the individuals are morons or are low-grade normals. In such cases the procedure followed was to give the individual the benefit of the doubt and not list him as feeble-minded unless the evidence was perfectly convincing. If the field worker was not convinced as to how he should be listed, he was left undetermined. The result of this method is to give a bimodal distribution of cases, since the border-line cases have been thrown out. We are not, therefore, dealing with a random selection, and the statistical results are correspondingly vitiated.

In addition to these border-line cases there was a large group that could not be classified because of deaths in infancy and other causes. The actual figures show that out of 1,752 offspring of various matings, 708 are rated as feeble-minded, 348 as normal, and a total of 696 as unclassified for various reasons such as death, doubtful cases, etc. The conditions, therefore, certainly do not justify any strong assurance that if it had been possible to classify the large unclassified group that they would have been found to show the same ratios of normals and defectives as was shown by the classified group.

In criticizing Goddard's method of collecting results, the writer is appreciative of the difficulties to be overcome and is inclined to the view that the results are as good as could have been secured under the circumstances, but it would be unnecessary charity to overlook the circumstances. And few mental testers would agree that it is possible to determine with much accuracy the Binet mental age of a person by anything short of an actual test.

It must be kept in mind that the definition of feeble-mindedness is arbitrary and that when we think of it in

relation to the total population the distinction between the feeble-minded and the normal is simply an arbitrary line drawn at some point so as to cut off the lower end of the curve of distribution for intelligence. In Goddard's use of the term all adults testing 12 years or less on the Binet scale were considered feeble-minded. If, then, we are dealing with a random sample of the population, it is clear that the relative number of normals and feeble-minded individuals is determined simply by the point at which we draw the arbitrary line. If we place the line at 10 years, we greatly reduce the number of mental defectives and correspondingly increase the number of normals. If, therefore, using a Binet mental age of 12 years as the dividing line, we had found by studying a random sample of the population that the mating of two normals with recessive deficiency gave a Mendelian ratio of 3 normal children to 1 feeble-minded, it by no means necessarily follows that the same would hold if we lower our arbitrary dividing line to 10 years of Binet mental age. Incidentally, as we have already shown, there are excellent reasons for considering 12 years as much too high to be used as the lower limit of normality.

Another evidence of selection is found when we examine the mental ages of the children who were inmates of the institution. On the basis of what we have learned from numerous tests as to the distribution of intelligence in the general population, we have excellent reason to expect that as we ascend the scale of mental age from the zero point to normality there will be an increase in the number of cases. If, therefore, we use 12 as the upper limit of mental deficiency and we have a perfectly random selection of cases, we should have more cases 12 years old than any other. In point of fact Goddard's table for the hereditary and probably hereditary cases shows no cases at all for the age of 12 years. Five cases are listed at 11 years and from there

the number increases to 37 at 8 years, which is the maximum number for a single year. This is, of course, the logical thing to expect, but at the same time it shows the danger of emphasizing too much the detailed results secured from the statistical treatment of such data.

Aside from these statistical considerations there are other reasons for hesitating before accepting Goddard's conclusion. In attempting to apply such a conception, it is necessary, in the first place, to discard the classification into feeble-minded and normal and speak rather of particular levels of intelligence, *i.e.,* 3-year intelligence, 7-year intelligence, 12-year intelligence, etc., and to assume that mentality of such levels is inherited *en bloc* and that the higher levels dominate the lower. If this were true, the intelligence of the children would always be of one of three grades: (1) that of the father, (2) that of the mother, or (3) that of the higher of the two recessives. *In no case would a child have a mentality higher than that of either parent.* It is admitted, however, that cases would occur and do occur where the children have mentalities lower than those of their parents.

Suppose we extend the above conception to the upper ranges of ability and assume that men and women of genius have inherited their mental capacity *en bloc* from indefinitely remote ancestors, we should find it impossible to substantiate such an idea by the facts available. To avoid this obvious difficulty, Davenport suggested that genius was also due to the absence of something and was recessive. If we apply this conception to some theoretical cases at different intervals on the normal distribution curve, it will lead to interesting results. Suppose, for example, that 14 is the normal mental age and we assume two parents with mental ages of 15 and 17 according to the Stanford Revision. This hypothesis would require that all of the children be either the same mental age as one of the parents

or *higher*. Parents slightly above average could not have children of less mentality unless indeed they are *below average*. (That case is not covered in the hypothesis.) If we further assume a mating of two individuals, one with a mental test age of 10 years and the other with a mental test age of 18 years, the logic of the situation would seem to require that their children should have mental ages of 10 years or 18 years or of more than 18 years or of less than 10 years. There would be no possibility according to such a theory for children with mental ages in between the ages of 10 and 18. This we know to be contrary to existing data on the subject.

The fundamental difficulty with any attempt to consider mental inheritance as being due to a single unit factor or determiner or as a unit character due to a group of determiners lies in the fact that it removes the possibility of the operation of a number of independent factors and so leaves no basis for explaining the known facts of variability. We, therefore, find it necessary to reject Goddard's tentative conclusion that feeble-mindedness is a unit character. We assume rather, with Thorndike, that it is very probably the result of very many unit factors which may be combined in many ways and with varied results as far as the degree of defectiveness is concerned. To settle this matter finally it would appear to be necessary to test carefully with a number of well standardized tests a large group of parents and children, preferably where there are many children in the family. It does not seem necessary that such an investigation be carried on with the families of mental defectives, because we may reasonably expect that when the laws of mental inheritance are understood it will be found that they apply to all grades of intelligence alike.

In rejecting Goddard's tentative hypothesis that mental deficiency is inherited as a unit character, we have no intention of rejecting the more important conclusion that de-

ficiency is inherited. On this point the evidence submitted by Goddard and other investigators is in substantial agreement. The majority of mental defectives have defective ancestry, and, even when defects cannot be clearly traced in the ancestry, there is the possibility that combinations of weak recessive traits are the real cause of the defect. The writer's view is that in fully three-fourths of the cases of feeble-mindedness heredity is the primary cause and probably in a considerable part of the other cases it is an important contributory cause. If there is a native weakness, it is likely to be brought out by the effects of disease or accidental injury.

Contributory Causes of Mental Deficiency

In Chapter VIII, on the effects of the environment, we have already considered the problem as to the ways and the extent to which various factors would affect normal development. Glandular disturbances may undoubtedly cause mental deficiency in some cases. These disturbances may be due either to hereditary glandular deficiency or to defects in the food and water supply. Serious defects in nutrition, long continued, might well affect the development of the whole body, including the nervous system. Absence of stimulation by direct sunlight may have the same effect. Diseases, as a rule, will have no permanent effect on a normal child. There may be a temporary arrest of growth, but normally after the disease is recovered from there is an acceleration of growth and all that has been lost is recovered. Failure of this process of recovery would in itself be an indication of constitutional weakness. There are, of course, certain destructive diseases, as meningitis, which produce permanent injuries, and these may produce permanent mental deficiency. But the total number of cases due to such causes is very small.

According to popular opinion a large part of mental de-

ficiency is due to such causes as alcoholism, syphilis, age of parents, consanguinity, maternal shock, etc. We have already examined these supposed causes in Chapter VIII and will not repeat the argument here. A fuller discussion of such problems may be found by consulting Goddard. None of these assumed causes is found uniformly to cause mental deficiency. They can, therefore, be considered as nothing more than contributory causes.

Prevention of Mental Deficiency

Prevention requires the removal of the causes of whatever is to be prevented. If, therefore, the fundamental cause of mental deficiency is heredity, the only effective way of reducing the number of defectives is to restrict in some way the breeding of the present generation of defectives. This might be done in two ways: by segregating all defectives in institutions at the expense of the state, or by sterilizing them and leaving them at large. Before either measure can be applied, a development of public opinion will be necessary. At the present time the public would not support such a measure. Even if either measure were applied, it would be necessary to continue the process for many generations, because cases would continue to appear; but the number would decrease with each generation.

If we view the problem of the prevention of mental deficiency in a somewhat broader light, we are justified in saying that mental defect is relative and so viewed is inevitable. Even if we were by selective breeding to raise the average level of intelligence by 2 or 3 years and eliminate nearly all cases of defect below 10 or 11 years, we should still have the population distributed according to the curve of distribution—slightly skewed perhaps—and those individuals at the lower end of the distribution would be considered defective. Their absolute intelligence would be higher, but in a competitive industrial civilization such as ours they

would be just as definitely handicapped. Socially they would still be at the bottom of the list.

If we cast sentimental notions aside and consider the actual facts of our present economic system, the problem of mental deficiency becomes somewhat less serious. There are many grades of work to be done, and some of these not only require a minimum of intelligence but are of such a character that they would be decidedly objectionable to men of high intelligence and high ideals. The streets must be swept, the sewers must be cleaned out, ditches must be dug, and a variety of other kinds of work must be done. Factory operations are essentially detailed and monotonous and so are objectionable to people with active minds, but factory work is efficient and is becoming more and more important. There is thus a place for many people of inferior mentality, if they have strong bodies. If they have a fair amount of motor ability, the openings for them are almost unlimited. This is a side of the question of deficiency that is often overlooked. The processes of evolution have usually worked out so as to secure a reasonable adaptation of organisms to environment, and so, without assuming too much as to the perfection of this adaptation, we are justified in asking whether raising the average level of intelligence of the population would be such an unmixed benefit as is commonly assumed.

As a matter of fact, objections to mental defect have not as a rule been on the grounds of the defect itself but rather on the grounds of the supposed consequences of such deficiency. Mental deficiency is often assumed as the basis of crime, particularly certain kinds of crime. This, if true, is a serious matter. It will be considered, however, in a later chapter.

Feeble-mindedness is also often associated in popular opinion, with insanity. Some varieties of defect do involve both insanity and mental deficiency. However, most de-

fectives are not insane and most of the insane cannot properly be called feeble-minded. The distinction between the two and the way in which they are related will be explained in the next chapter.

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CHAPTER XIV

EXTREME DEVIATIONS IN MENTAL TRAITS: III. FANATICISM AND INSANITY

Conflict of Views on Insanity

Among primitive peoples and even until relatively recent times among civilized peoples, the insane have been supposed to possess evil spirits. If the evil spirit could be driven out, the sufferer would recover. With the development of modern medicine insanity came to be regarded as a disease, and medical investigators sought for its cause in infections, toxic disturbances, tumors, and hemorrhages. The mental symptoms were not in themselves considered as having any causal significance. If the underlying organic condition could be removed, the mental disorders would naturally disappear. It should be noted, however, that the mental symptoms of insanity were rather generally regarded as being of a nature quite different from the normal.

A later development in the conception of insanity is found in the Freudian interpretations. Briefly, the Freudian view is that due to a maladjustment between the individual's desires and his environment an emotional conflict develops. This conflict is not solved in any satisfactory way. The unsatisfied desire is repressed, is dissociated from the normal and dominant self, and begins from the subconscious to exert various undesirable influences on the activities of the individual. At first this conception was applied chiefly to the interpretation of hysteria and re-

lated phenomena, but there has been a tendency on the part of some to apply Freudian ideas much more widely and to consider psychological disturbances the essential cause of much insanity.

Still a different view as to the cause of insanity is held by some who maintain that, for certain kinds of insanity at least, an inherited predisposition is the most important factor. Thus it is evident that the experts do not agree on what is the fundamental nature of insanity.

Generally speaking, insanity has been regarded as abnormal and pathological. In so far as this conception is held, we are not here interested in it, for our problem is rather to study the deviations resulting from the action of ordinary biological forces. It is, of course, true that some at least of the insanities are due to physical disease. In spite of this, however, the present chapter will endeavor to show that the mental phenomena of insanity can be interpreted mostly if not entirely as being extreme quantitative variations—not qualitative differences—from the normal.

Definition of Insanity

Tentatively we shall define insanity as a condition which, whether resulting from tumors, hemorrhages, infections, intoxications, hereditary defects in the nervous system, exhaustion, or emotional conflicts, results in a loss of rationality, mental balance, and socialized self-control to such a degree as to cause serious irregularities in behavior. If feeble-mindedness is thought of as a lower level of mentality, insanity is thought of as a disordered and unbalanced mentality.

Mental Variations in Insanity

Sensory disorders are frequently encountered in insanity, but their importance is relatively small. The affective tone

in insanity is at times pleasant but is more characteristically unpleasant. Motor strength, skill, and resistance to fatigue are usually decreased. This can be regarded as one of the most important general characteristics of the insane. The instincts and emotions are especially subject to disorder. Violent emotional disturbance when found is to be taken as an indication of lack of emotional control rather than as an indication of great strength of the emotions. It is probably nearer to the truth to say that the emotions of the insane are below the normal. This may well be due, however, to exhaustion rather than to original deficiency. The sense of humor and tendency to laugh off the mental effects of a blunder—which implies breadth of view—are usually impaired. Another emotional difference of the first degree of importance is the overdevelopment relatively of the egoistic emotions. Little altruism is to be found among the insane. Delusions of grandeur in which the patient thinks he is a king or a god are examples of the tendency to glorify the ego. Power of voluntary attention is very largely impaired in most forms of insanity. In opposition to this we find on the one hand a tendency to scattering of attention and on the other a tendency to fixate some one thing and be unable to think of anything else. Imagination and perception are normally distinguished fairly sharply, but in the insane the distinction breaks down. False perceptions are much more common. Voices are heard and visions are seen. While normal individuals rarely have hallucinations except in sleep, the insane often have them when awake. Memory suffers both in the direction of simple impairment and in the direction of falsification. Loss of memory is likely to be regressive in that the last things learned are the first to be forgotten. The falsification of memory is the natural result of its impairment and the great activity of the imagination. Associations become less logical and more subject to the influences of emotional

complexes and chance connections. Defects in reasoning are of especial importance. One of the most important phases of this is the loss of the ability to weigh and evaluate evidence and accept a rational conclusion. This gives rise to all kinds of delusions. A false idea becomes fixed and in spite of contrary evidence is firmly held and believed. This is the characteristic which makes the insane particularly dangerous. If they conceive the idea that they are divinely appointed to kill their neighbor, no amount of evidence will convince them that they are in error.

Relation of Insanity to Intelligence

Amount of intelligence is not a great factor in insanity. Insanity may be associated with mental deficiency. Many cases which combine the two defects are found. Insanity may occur in ordinary average citizens. Or again insanity may be found in the exceptionally superior. There is, however, no real justification for the common belief that genius and insanity are closely related. It is certainly not correct to say that all of the insane were near-geniuses; neither is it correct to say that all geniuses are near-insane. The genius is often thought to be insane until he succeeds in his enterprise and then he is accepted perhaps as a great man. His thoughts are so far removed from those of the crowd that they are unable to grasp them. If the concrete results of his thinking are sufficiently understandable and demonstrably correct, his standing with the public correspondingly improves. But if he does not reach the point of concrete demonstration, he is very likely to be rated as mentally unbalanced. Certain kinds of insanity do, indeed, occur most often among the gifted classes, but other kinds occur more often among the less gifted group and it is, therefore, unsafe to draw any general conclusion.

Varieties of Insanity

It is not our purpose to attempt anything more than a very brief outline of the insanities. Texts on psychiatry should be consulted by those interested in a detailed and comprehensive treatment. All that is desired here is to show the relation of some of the characteristic phenomena of insanity to normal mentality. We shall classify the insanities in eight groups on the basis of probable major causes. This classification, though not complete, includes nearly all cases of insanity.

Insanity Due to Tumors.—Tumors are masses of tissue which grow in erratic and unregulated manner and may attain considerable size. In an enclosed area, such as the cranial cavity, this necessarily results in pressure and displacement of the surrounding tissue. The symptoms will be determined by the location and by the amount of this pressure and displacement. It so happens that most brain tumors are found near the base of the brain, either in the region of the thalamus or around the brain stem and cerebellum. The reason for this cannot be stated with certainty, but, since irritation seems to be one of the potent causes of tumor growths, it is not improbable that the friction naturally encountered by these basal structures largely determines the greater development of tumors in this region.

The symptoms in tumor insanities are very variable but are likely to involve disturbances of emotions and motor control with resulting impairment of volition. They do not present any features of special interest to the student of individual differences.

Insanity Due to Infections.—Another group of mental disturbances without any regularity of symptoms is due to brain abscesses. These may be located in practically any brain area and because of this fact they show symptoms which vary with the areas affected. They may cause simple loss of function or loss of mental balance or both.

A more important variety of insanity resulting from infection is found in general paralysis, technically known as dementia paralytica. This is the fourth and final stage of lues and develops in about 5 per cent of the total number of cases of luetic infection. Most of the cases do not go that far. This in itself is a very interesting fact and shows that not only is the infection necessary but that a lack of resistance on the part of the individual is also necessary to reach this final stage. The organism causing the disease, the spirochæta pallida, attacks the nerve cells directly and destroys them. Many of them completely disappear from the cortex, being absorbed and carried away by the blood. Their places are taken by neuroglia, or supporting cells, and as a result the cortex is much hardened. This destructive process may involve the whole cortex. The inevitable result of such disintegration is a loss of mental capacity. In the progress of the disease this finally becomes absolute. With this goes a loss of motor capacity and control. The essential symptoms are thus summarized in the name, dementia paralytica.

By following the disease in greater detail one may enumerate the loss of memory in a progressive way, the loss of judgment and reasoning ability, the loss of power of attention, and so with other mental processes. Generally speaking, the higher powers are the first to go, just as in tearing down a building the top is removed first. In this respect the phenomena of general paralysis may be compared to those of senescence.

Other infections, as influenza, may cause such a serious injury to the nervous system that something approaching temporary insanity results. Ordinarily in such cases complete recovery takes place in a few months.

A still more temporary condition is found in fever delirium which may result from infection. When a person gets into a high fever there may be hallucinations and

erratic associations such as are found in some forms of insanity. We do not ordinarily say that such people are insane. We simply say that they are "out of their heads," but in reality they are for the time being unbalanced.

Insanity Due to Intoxication.—Toxic conditions in the system, whether produced by disease, inhaling poisonous fumes, drinking too much alcohol, or other causes, may lead to serious but usually more or less temporary disturbances of mentality. As an example of this we may take delirium tremens. Ordinarily this is caused by excessive and prolonged consumption of alcohol. If complicated by pneumonia, as not infrequently happens, death may result; but in the absence of complications a recovery may be expected. It is thus essentially a temporary condition. The striking symptoms in this disease consist of hallucinations, which are often pleasant but are more generally of a terrifying character. Great disturbance of the associative processes naturally occurs also.

Insanity Due to Normal (?) Involution.—Our knowledge of growth is much more complete than our knowledge of old age with its accompanying disintegration. There is, however, in all cases, a decline in abilities with advancing age. Just when this decline begins cannot be stated with certainty, because it, like other things, is subject to very great individual variations. Impairment of physical capacity apparently begins before impairment of mental capacity; some think there is an increase in mental capacity in brain workers even after the physical mechanism has begun to break down. In any case, there is eventually a slowing down of brain processes and a loss of mental plasticity. In many cases this does not go very far before death results from some cause outside of the nervous system. The heart or digestive system may fail while the brain is still working effectively. Under such conditions we naturally do not find very important nervous

disorders. In other cases, however, the nervous system and the endocrine glands may begin to disintegrate before the other systems, or the nervous system may be affected by diseases of bodily organs with resulting mental symptoms. It is a relatively common occurrence for old people to show signs of mental decay and to become queer and eccentric. Ordinarily this is passed over without serious consideration, but in some cases it goes to such an extreme degree that it results in the confinement of the individual in a hospital for the insane. These cases show nothing very striking to one familiar with the phenomena of old age. The senses are usually impaired, the perceptual powers decreased, memory suffers greatly, especially for recent events, the emotional life is likely to be disturbed, and the sufferers are likely to show decidedly egoistic and selfish emotional tendencies. Motor ability is greatly reduced. Judgment and reasoning suffer to a marked extent and with this frequently goes the development of delusions.

Insanity Due to Disturbances in the Circulatory System. —Defects in the circulatory system may be responsible for the development of insanity. The most common of these defects are hardening of the arteries, technically known as arterio-sclerosis, hemorrhages, and occlusions due to the presence of thrombi or emboli.

Old age is normally associated with some hardening of the arteries and in many cases this goes to the point that any considerable increase in blood pressure results in a more or less extensive hemorrhage. When this occurs in the brain there is ordinarily a destruction of nerve cells with resultant loss of function. These lesions may be in any part of the brain and may be of many degrees. It is, therefore, impossible to generalize as to their mental effects.

The occlusion of blood vessels may be due to foreign bodies or to blood clots or, in particular cases, to free fat cells. These may travel through the circulatory system

until they reach a point where a blood vessel divides or otherwise becomes so small that further passage is impossible. Under such conditions the normal circulation of blood is seriously reduced or even stopped with consequent disturbance of mental processes. According to one theory, many cases of shell shock were due to the occlusion of capillaries by fat cells released from some part of the body by the effects of a shell fragment striking a bone or other solid part of the body and so jarring the cells loose. When these started from the arteries through the capillaries in the brain in the direction of the veins, they lodged and stopped the circulation.

As in case of brain hemorrhages, it is impossible to generalize on the effects of occlusions of cerebral blood vessels. A great variety of symptoms results. However, it should be clear that thrombi and emboli are important possible causes of insanity.

Insanity Due Largely to Inherited Defects in the Nervous System: Dementia Præcox.—Dementia præcox is so named because it is a condition of mental disintegration which comes on prematurely. It appears ordinarily in adolescence or in early adulthood. There are three forms: the hebephrenic, the catatonic, and the paranoid. The hebephrenic form is the most characteristic and is characterized chiefly by mental degeneration. There may also be delusions, but these are not prominently developed. In the catatonic form there is less mental degeneration and greater hope of recovery. The name is based on the peculiar fact that in these patients we find a condition of uniform muscular tension with the result that when a limb is placed in a particular position it tends to remain there. The head may be held for some time above the pillow, or the arms may be held in a horizontal position without support. During this time the patient is in a condition of stupor apparently, but patients often show that they remember the events

which took place at the time when they were not supposed to be able to understand what was going on. The paranoid form is characterized especially by the presence of delusions. These are especially likely to be of persecution, though they may be of other kinds. All three forms show mental deterioration.

Manic-Depressive Insanity.—Manic-depressive insanity, also known as circular insanity, is characterized by alternate periods of great excitement, or mania, and periods of depression. In the period of excitement the patient may be violent but is often cheerful and happy. There is a free flow of language but without logical continuity. In the depressed phase the patient may lie in bed without showing any interest in anything. Delusions are generally present in the manic phase of the disease.

The average individual is subject to alternating periods of excitement and depression and the phenomena of manic-depressive insanity suggest that it is simply an extreme degree of this normal mental periodicity. It seems plausible that this periodicity is linked up in some way with the balance of the glands of internal secretion, but so far it has not been possible to verify this supposition.

Paranoia.—Paranoia is usually a disorder of later years. It is characterized by systematized delusions. These may be expansive: the patient may think himself a king or a great financier or a special prophet of the Almighty. Or they may be delusions of persecution: the patient may think that he is the victim of some special conspiracy, that people are plotting to take all his property, to kill him secretly, and so on. Married patients may suspect that their mates are unfaithful to them and may resort to all manner of devices in order to catch them in secret trysts with their supposed lovers.

Other mental functions in paranoiacs may be approximately normal except for those involved in the acceptance

of the delusions. The observed defect is one of judgment, but this in turn involves errors in meaning, in emotional attitudes, and in inferences. The fundamental difficulty is probably in the emotions and in an uncontrolled imagination.

The essential nature of a delusion is the inability to receive and accept the facts of experience in a rational way. This is most evident when new experience is of such a character as to require the changing or the abandoning of accepted views. From this point of view senescence may be said to be characterized in general by the presence of delusions. It is quite generally recognized that old people do not readily change their views; they do not adapt themselves so readily to new situations; they are by nature conservative; and this means that very often they do not grasp new truths as real. This does not mean that youth is free from delusions in the ordinary sense of the term—far from it. But in the technical sense in which we use the word here, a delusion is a false idea which is proof against contrary evidence, and while youth has many false ideas, youth is more plastic and more readily accepts opposing evidence and changes its views to suit the facts. This the paranoiac is unable to do, and so we are justified in pointing out the close relation between the extreme delusions of the insane paranoiac and the absence of mental plasticity on the part of the aged. Paranoia is, then, only a quantitative variation from what may be regarded as normal senescent characteristics.

Melancholia.—Melancholia is a condition of extreme habitual depression which occurs more commonly in the later years. One of its common symptoms is the presence of delusions of a depressive nature. One patient said that she had been dead for four years, that she had swallowed the sun, that her blood vessels were filled with iron, and she also said other inconsistent and impossible things. These ideas

are fixed and the patient will tell the same stories for years.

While it can hardly be said that senescence is characterized habitually by depression, if we compare it with youth we should certainly call it less hopeful and optimistic. Melancholia is probably due to the regression of organs and functions that normally make for a more cheerful state of mind, but just what these are we are not at present able to state.

Epilepsy.—Epilepsy may be brought on by injury to the brain, but we have in mind here the cases that show a history of epilepsy in the family. The disease may appear at almost any age. It is more likely to be brought on by excessive excitement and nerve strain, though it may appear when there has been no unusual set of experiences as a basis. In the simpler forms there are seizures with unconsciousness which last a few seconds or minutes and without any other important symptoms. Mental deterioration to a greater or less degree takes place. In the more violent cases there are severe "fits" with violent spasmodic contractions of the muscles and frothing at the mouth. These usually last only a few minutes but may leave the sufferer in a weakened condition. In some cases the epileptic becomes irrational and dangerous when the seizures approach and for that reason he has to be confined.

Mental-test results of epileptics are peculiar in that they show a much greater scattering than is characteristic of either normals or mental defectives. In some cases at least, this has an anatomical correlate in the failure of nerve cells in certain parts of the cerebral cortex to complete their development. Certain parts of the cortex are relatively well developed while others are very poorly developed. Some of these conditions are at least congenital, and the family histories would suggest that they are hereditary.

Insanity Due to Exhaustion: Neurasthenia.—Neuras-

thenia may be classified as hereditary or as acquired depending on the conditions of its onset. We are considering here the cases due primarily or at least largely to environmental influences.

Neurasthenia is characterized by a condition of nervous exhaustion with a greater tendency to mental fatigue. There is a condition of anxiety and lack of emotional control and a tendency to exaggerate mental and bodily ills and to imagine numerous defects and diseases that are not present.

This disturbance is so much more common in America than in other countries that it is often called the *American disease*. It is due largely to the fast life and the greater mental strain under which Americans live. It is also probable that Americans as a class have been selected from those who were more restless and excitable and so were less satisfied with life in Europe. In general it is the most ambitious and energetic and often the most talented who suffer from the disease. Great ability seems often to be linked with great susceptibility to fatigue. It is probable, however, that neurasthenia is due fundamentally to emotional conflicts and worry rather than to overwork. Excessive work, if not complicated by digestive disorders or insomnia, should not produce neurasthenia, because the loss of energy by activity would be made up by food and sleep; but when emotional conflicts and worry enter the arena, digestion is disturbed and insomnia appears. The nervous exhaustion is then produced directly by the interference with normal sleep and digestion. Once the vicious cycle is started, it becomes progressively worse until the emotional disturbance is removed or until so much energy is lost that through sheer exhaustion the causes of the worry are disregarded.

While there is some loss of ability in neurasthenia, there is a clear consciousness of the loss on the part of the sufferer,

and in this respect neurasthenia differs from the typical insanities.

Hysteria.—While emotional conflicts and worry may in some cases lead to neurasthenia, in other cases they lead to hysteria. Hysteria is essentially a psychological condition and may be described as a dissociation of consciousness resulting from the submergence into the subconscious of emotional complexes that are antagonistic to the dominant self. There are no regular physical symptoms or nervous changes. The phenomena may be regarded as largely functional though very possibly with an organic basis. The psychoanalytic school of psychologists and psychiatrists have done much to clear up these disorders and the student must read the more extensive discussions to get a clear understanding of the causes and symptoms. As long as psychoanalysis is confined to mental ailments of this order it is very useful, but it is necessary to protest against its application on the same basis to the hereditary mental diseases. They may indeed show symptoms similar to those of hysteria, but they cannot be cured by the same treatments.

General View of Insanity

We have noted briefly a few of the outstanding mental symptoms of the insanities. Our purpose has been to show how these are related to our general conception of individual differences. It will be useful here to summarize our conclusions. In the first place we may note that no mental phenomena appear in the insanities that are qualitatively unlike the mental phenomena of ordinary life. Hallucinations and delusions are not peculiar to the insane. So with the other phenomena of insanity, we find them in lesser degree or less often in ordinary citizens. Many of the phenomena of mental degeneration encountered in insanity are suggestive of premature senescence, either general or

partial. The difference is again quantitative. When insanity is caused by an abscess or by a tumor, we may have a deranged or an impaired function, but there is nothing new added. In short, then, some functions may be lost and others may be weakened, or all may be weakened but to different degrees with a resulting loss of balance, and these disorders may give rise to extreme degrees of peculiar and objectionable conduct, but there is nothing fundamentally new. It is unnecessary to invent any new categories in order to describe the individual deviations of the insane. The insane simply show to an extreme degree certain objectionable or lamentable mental characteristics which are found in the average citizen. One student, after reading a text on the psychology of insanity, very truthfully said that he had learned more about normal people than he had by reading a number of texts on normal psychology.

Insanity and Religion

In view of the very important position occupied by religion in life and especially because of its close relation to the emotional life, it is natural that religious ideas should be involved in the insanities. It is also only natural that many of the insane should have many religious hallucinations and delusions. As a matter of fact, the insane do have such in large numbers. They see visions and hear the voice of the Lord telling them various things. Because of the veneration which people have for religion, there is always a danger that when insane people are at large and have such hallucinations and delusions they will be accepted uncritically. The history of religions is filled with phenomena of this kind. One of the popular revelations has been that the world would end on a particular date, and crowds of dupes have more than once gathered to be ready for the end. If the public at large had a better understanding of the aberrations of abnormal mentality, it is safe to say that religion

would be relieved of a weighty encumbrance. Certain religious movements have been supported largely by the near-insane. Extreme religious fanaticism shows many phenomena of insanity, but it is difficult to criticize it on such a basis because of the great danger of being misunderstood. Fanaticism of all kinds, of course, belongs in the same class; but religious fanaticism, because of the importance of the issues involved, is likely to be more extreme than fanaticism of other kinds.

An example of semi-religious phenomena which often involve insanity is found in the spiritualistic movement. There can be no doubt that many of the mediums who claim to receive messages from the dead are in fact suffering from hallucinations. They may hear voices, but the voices are within and not without. Other mediums are, of course, plain frauds looking for easy money.

The Prevention of Insanity

Practically nothing can be done to prevent insanities due to tumors and abscesses of the brain. Insanities caused by specific diseases and by poisons are naturally to be avoided by avoiding the cause. We are not concerned with these.

It is not possible to say with certainty just how senile dementia may be avoided, but it seems reasonably probable that the avoidance of prolonged worry and excessive bodily fatigue would do much to prevent the danger of excessive mental disintegration in old age.

When there is a hereditary disposition towards nervous and mental derangement, a quiet and sanely ordered life is imperative. Excessive mental or physical strain or the weakness resulting from a severe illness may suffice to bring on the insanity. Avoidance of emotional excitement and worry is, however, most important. Rural life rather than city life is to be advised.

Neurasthenia is to be prevented by adequate diversions

and avoidance of worry. Adequate self-control is essential. A sense of humor and the ability to see things in their proper perspective, along with the right kind of social contacts, should go a long way to prevent excessive worry; but an adjustment of desires and ambitions to opportunities is also necessary.

Hysteria is to be prevented as far as possible by avoiding its cause, but a knowledge of abnormal psychology should also be a great help. The understanding of the mental mechanisms involved would tend to prevent the development of the more extreme phenomena.

In brief, physical and mental hygiene are necessary to prevent insanity. There are, of course, enormous individual differences in susceptibility to the development of insanity. Some people can stand more than others. The individual must become acquainted with his capacity for resisting strain and always keep well within the danger line.

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CHAPTER XV

EXTREME DEVIATION IN MENTAL TRAITS: IV. DELINQUENCY AND CRIMINALITY

Historical Conceptions of Criminals

Primitive and mediæval thinkers were usually disposed to explain irregular conduct by the supposition that the individual was possessed by a spirit—or perhaps by a group of spirits. This method of explanation was easily applied to criminals and led naturally to the supposition that the criminal was such because the devil or one of his special agents had control over the unfortunate man. In the early modern period with the great emphasis on individualism and freedom of the will it was supposed that criminals were such because they freely chose to be. This was the basis of some of the most severe punishments; hanging was not infrequently the penalty for a petty offense. The beginning of a more scientific point of view was found in the work of Lombroso, who urged a study of criminals as a basis for their treatment. Unfortunately, however, Lombroso did not himself study criminals very carefully and as a result he set forth some very questionable views as to the nature of the criminal class. According to him, criminals represented a distinct hereditary type and it was possible to distinguish them from the rest of the population by the presence of certain physical irregularities or stigmata. More recently the view has been championed, especially by Goddard, that criminals are such because of defective intelligence. The evidence bearing on these views will be examined later.

Difficulties in the Study of Criminals

At the outset we should recognize certain difficulties in the way of a satisfactory study of criminals. In the first place, the criminals studied are the caught and convicted criminals. This eliminates all of those who commit crime and escape. The importance of this factor is indicated by the fact that in the five-year period, 1918-1922 inclusive, there were a total of 916 homicides in Manhattan Borough, New York, and in the same period there were 250 convictions for homicide. The convictions ranged from murder, first degree, to manslaughter, second degree. Of course, some of the homicides were accidental and others were justifiable, but at least two-thirds of the criminals involved escaped. Such statistics as we have on the convicted group are, therefore, not to be accepted too implicitly as reliable indications of the characteristics of criminals as a group. In the second place, it would only be human nature if the criminals studied gave out a relative excess of the information favorable to their cases. For example, statistics indicate that a higher percentage of criminals are church members than is true of the population at large. This may be true, but it is more likely that it represents an attempt on the part of criminals to show that their intentions have been good. If a criminal's mother died when he was young, he is pretty likely to report the fact, but if she is still living, he is less likely to report it. Some criminals refuse to discuss their cases with investigators and this necessarily casts additional doubt on the reliability of the conclusions.

Accurate measurements and reliable statistics must form the basis of any satisfactory discussion of criminals. It should, however, be evident that a too complete reliance on existing experimental and statistical results may lead to more serious error than would a more speculative treatment.

The Psychological Nature of Crime

Crime is ordinarily egoistic, anti-social. It consists in satisfying or attempting to satisfy one's personal desires in ways which run counter to the social will as expressed in the laws. It is, then, usually due to failure of social or other tendencies to inhibit egoistic instincts. Many individuals who have never committed a serious crime have at times had the desire to commit murder; others have had the desire to steal, and others to commit still other serious crimes. That these desires have not been carried out may have been due to fear of detection and punishment in part, but it may also have been due in many cases to more positive social feelings such as unwillingness to cause pain to others. In any case, the normal individual inhibits these anti-social tendencies while the criminal does not do so. Psychologically, then, crime is due essentially to the absence of inhibitions under certain specified conditions.

Classes of Criminals

Criminals have been classified in many ways, but from our point of view it is most satisfactory to classify them on the basis of the instinctive drives which, not being inhibited or controlled, cause the crime. On this basis most crimes may be said to be due to acquisitiveness, pugnacity, or sex. Statistics show that from two-thirds to nine-tenths of all criminals commit crimes of an acquisitive nature, such as theft and fraud. Glueck's study of 608 admissions to Sing Sing showed 63.8 per cent in the acquisitive group, 24.3 per cent in the pugnacity group, 9.9 per cent in the sex group, and 2.0 per cent due to other tendencies. The exact figures found will depend on the institution studied. In case of women, however, there is a great preponderance of crimes involving sex. They are much less frequently convicted of crimes of acquisitiveness and of violence, but in spite of this fact it is still correct to say that most crimes are of an

acquisitive nature. In fact women's sex crimes quite generally involve the acquisitive factor. Some crimes, of course, involve a combination of motives, but it is usually easy to point out the predominant factor.

Sex Differences in Criminality

One of the outstanding facts about crime statistics is the great difference in the numbers of male and female crim-

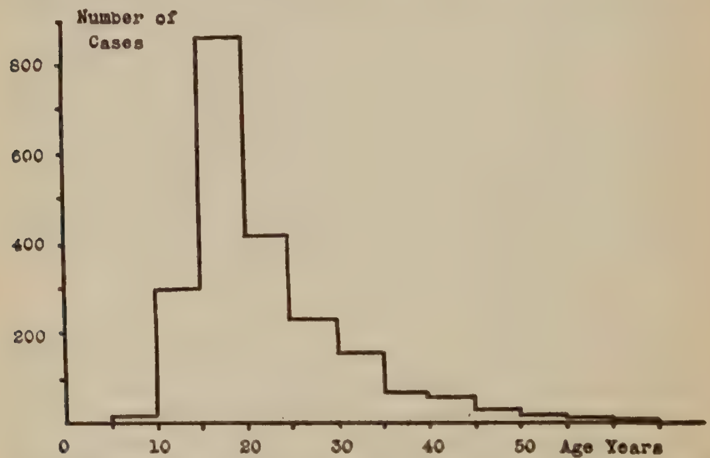

FIG. 40.—THE AGES AT THE TIME OF FIRST CONVICTION OF 2,204 HABITUAL CRIMINALS.

The mean age is 22.35 and the median is 19.58. (Based on Table 76 from Goring.)

inals. In New York State in 1922 only 4.4 per cent of the individuals convicted in courts of record were women, and in the courts of special sessions only 6.4 per cent were women. Women fall far short of supplying what we might call their proportionate supply of criminals. In the study of women delinquents in New York State, Fernald, Hayes, and Dawley report that only 16 per cent of the cases studied were not serious sex offenders, though they may have been

imprisoned on different grounds. This is sufficient to show the marked difference between male and female offenders. To be more accurate, there is no great difference between the sexes in kinds of crime committed when felons are compared, but when misdemeanants are compared there is a great excess of women convicted of sex crimes. This is due probably more to the nature of our laws than to anything else; on the other hand, there is no doubt at all that women less often commit crimes of a violent or acquisitive nature.

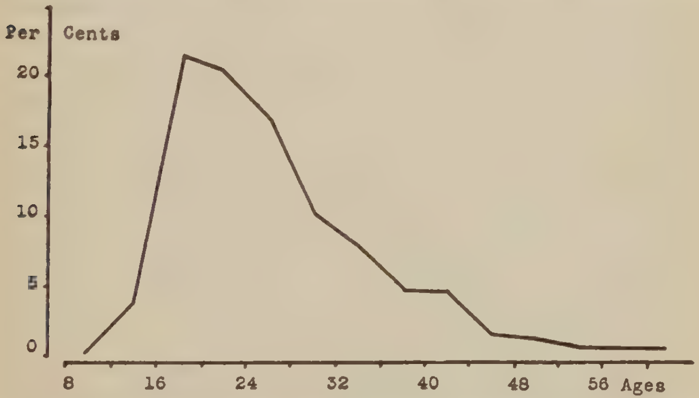

FIG. 41.—THE AGES AT THE TIME OF FIRST CONVICTION OF 555 WOMEN DELINQUENTS. (Based on data from Fernald, Hayes, and Dawley.)

This is in agreement with conclusions reached in Chapter X on the question of instinctive and emotional differences between the sexes.

Ages of Criminals at First Conviction

The average criminal is first arrested and convicted at a comparatively early age. This is shown convincingly by the figures collected by Goring and by Fernald, Hayes, and Dawley. Figures 40 and 41 show the age distributions for these groups. About half have been convicted by the age of 20. Very few become habitual criminals in later life.

In fact, it is probable that those first arrested after the age of 30 have in most cases been guilty of crime before then but have escaped being caught. This agrees with the idea expressed by James that character is pretty well fixed by the age of 25.

Physical Traits of Criminals

Lombroso advanced the view that criminals were distinguished by various physical defects or stigmata. Many people still believe this to be true. However, Goring's study of more than 2,000 English criminals showed that physically a criminal type did not exist. When measurements of criminals are compared with measurements of average individuals only one difference is found: criminals are on the average slightly smaller than the general population. For example, thieves and burglars are 1.8 inches shorter and 5.6 pounds lighter than the average of the population. Criminals guilty of fraud are about the same height and weight as the general population. The average difference is so small that it is of no great consequence and clearly it could not be used as a means of diagnosing criminality.

Women delinquents and criminals, on the other hand, are shorter but heavier than women in general. The 88 cases studied by Weidensall had a median height of 61.5 inches and a median weight of 129 pounds. This would be about 2 or 3 inches shorter than college women and about 10 pounds heavier. Healy finds the same general result in case of delinquent girls, and he further suggests that early overdevelopment may be a potent cause of sex delinquency. This is plausible and logical. It is sufficient to account for the greater weight of female delinquents.

While the finding of small average differences between the height and weight of criminals and of ordinary citizens is of some interest, it is of little practical importance. The overlapping of the two groups is so great that no conclusions

can be drawn in individual cases. Goring's work has effectively evaporated Lombroso's theory of a physical criminal type.

Several studies have found male delinquents and criminals to be inferior to the normal in strength and endurance. This might have some significance as tending to show that criminals become such through lack of energy. Stealing looks easier than working. Also, the weaker individuals would be more likely to be out of jobs and so there might be greater stimulus to steal. At most, however, this is only a tendency and is of no value in dealing with individual cases, because not all weak individuals are criminals nor are all criminals weak.

The Intelligence of Criminals

Goddard in particular has supported the view that many criminals are such because of mental deficiency. We are told that the feeble-minded are especially likely to become criminals. In *The Criminal Imbecile* Goddard reports three cases of crimes committed by three men and boys with mental ages of 9, 10, and 11 years. These are offered as examples of the great dangers of mental deficiency.

The writer once saw in a daily paper an account of a mental test of a murderer and, although his mental age by the Binet test was 12 years and 11 months, it was seriously urged that all individuals with such a low mentality should be locked up as being too dangerous to be at liberty. This would mean that about three-quarters of the Negro population and nearly half of the white population would have to be thus incarcerated. As one witty student remarked, it would be cheaper in the state where the crime was committed to lock up all of those above the Binet mental age of 13 years than it would be to lock up those below that age. Even if we were to accept Goddard's cases with Binet mental ages of 10 and 11 as representing dangerously in-

ferior mentalities and were to decide to lock up all with mentalities of less than 11 years, the financial cost would be staggering.

Fortunately, we are supplied with direct measurements of the mental capacities of criminals. These enable us to determine with greater precision the connection between intelligence and crime. Glueck, using mental test results and other data, concludes that among the 608 admissions to Sing Sing studied by him there are 5 with mental ages of less than 9 years, 21 with mental ages of 9 to 10 years, 14

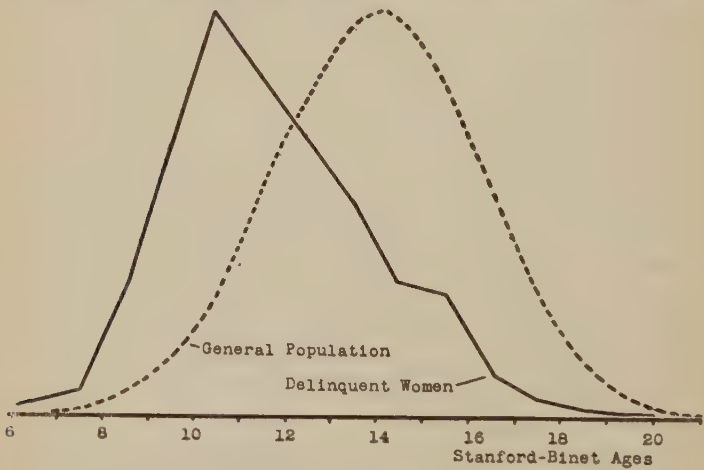

FIG. 42.—THE STANFORD-BINET MENTAL AGES OF 447 DELINQUENT WOMEN AS GIVEN BY FERNALD, HAYES, AND DAWLEY, COMPARED WITH THE HYPOTHETICAL DISTRIBUTION OF THE MENTAL AGES OF THE ADULTS IN THE GENERAL POPULATION AS SHOWN IN FIGURE 46, P. 453.

with mental ages of 10 to 11 years, and 58 with mental ages of 11 to 12 years. Many groups of 608 in the general population would show a higher number of cases of low-grade mentality. Fernald, Hayes, and Dawley report the mental ages of the women studied by them. The distribution of the mental ages is shown in Figure 42. The curve is dis-

tinctly skewed and the mode is below the general population average. At the same time, it is very important to note that we do find very intelligent women criminals. Murchison, also Landis and Arps, find that criminal white women have less intelligence than the general population of white women, but they find that criminal Negro women have more intelligence than the general population of Negro women.

Healy and Bronner (1926) have determined and tabulated the I.Q.'s of 1,625 delinquent boys and 701 delinquent girls. These calculations were made on the basis of an adult mental age level of 16 years. The distribution for the boys is practically a normal curve with the median at 90. The curve for the girls is not so symmetrical and normal, but also has a median of about 90. After pointing out that 16 years is too high for the average adult, the writers then point out that what on their chart is reckoned as an I.Q. of 90 is near the median for the general population. From this the logical conclusion is that the correlation between intelligence and tendency to become delinquent is practically zero.

The most extensive study of criminal intelligence has been made by Murchison. He quotes the findings of the Army psychologists showing the comparative scores on the Army tests of the Leavenworth prisoners and of the Army at large. The distribution of the two groups is as follows:

Letter Groups	Army	Leavenworth Prisoners
	Per cent	*Per cent*
E	7.0	6.0
D	17.0	18.8
C—	23.8	20.8
C	25.0	23.8
C+	15.2	16.0
B	8.0	8.8
A	4.1	5.8

Army prisoners are clearly not significantly different in intelligence from the Army at large. Such difference as exists in the above figures is in favor of the prisoners. Murchison has tested the inmates of a large number of state prisons and has compared these with the Army test scores of soldiers from the same states. This comparison based on 94,004 soldiers and 3,368 criminals is as follows:

Letter Groups	Criminals	White Draft
	Per cent	*Per cent*
E	7.5	7.5
D	6.9	8.8
C—	17.8	21.4
C	28.5	28.7
C+	22.8	18.8
B	11.4	9.7
A	5.3	5.1

Here again the difference is in favor of the criminal group, but the even more significant fact is that there is no great difference between the criminals and the draft group.

Fernald, Hayes, and Dawley compared 44 women felons in Auburn Prison with 473 men felons in the same prison, using the Yerkes-Bridges point scale, and found the average score of the women to be 72.73 and that of the men to be 72.66.

If, instead of speaking of criminals in general, we studied special groups of criminals, we should find considerable differences in average mentality. Credit criminals and those guilty of fraud would show a very high average intelligence. Goring's study showed that the professional classes supply a large number of criminals of this class. Crimes of violence, petty thievery, and sex crimes are more likely to be associated with low intelligence. It is, as Murchison points out, not intelligence or the absence of intelligence that makes a criminal; but the amount of intelligence

the criminal possesses may have a great deal to do with the kind of crime committed. The imbecile may steal something of little value, but the intelligent criminal will go after a larger amount. The imbecile may use violence, but the more intelligent criminal will substitute cunning for violence.

It is perhaps worth while to recall here that some 16 per cent of the cases of British genius studied by Havelock Ellis had at some time been in the clutches of British law. Some may have been guilty of nothing worse than being in debt, but in the sight of the law they were criminals.

The general conclusion to which a study of criminal intelligence leads us is that there is no significant correlation between level of intelligence and tendency to commit crime. There is, however, a positive correlation between intelligence and kind of crime committed.

Insanity and Crime

Much emphasis has been placed on the relation between crime and insanity. From time to time the daily papers contain accounts of terrible crimes committed by insane persons. This tends to give the impression that a large part of crime is due to insanity. Of the delinquent women studied by Fernald, Hayes, and Dawley, 4.1 per cent had been in hospitals for the insane. In view of their comparative youth, it is safe to say that the final percentage of those who showed symptoms of insanity would be considerably higher. Glueck reports that 5.9 per cent of the 608 admissions to Sing Sing suffered from dementia præcox and a total of 12 per cent suffered from some mental disease. This last figure is probably fully high enough if not too high for the general relation between criminality and insanity. In any case it appears evident that while criminals show a relatively high insanity rate, the actual number of insane criminals is only a small fractional part of the total number of criminals. Also it should be said that only

a small number of the insane ever commit a crime. Lombroso supposed that epilepsy and crime were very closely connected; he even went so far as to say that criminality is a form of epilepsy. Statistics show a higher percentage of epilepsy among criminals, but the figures are far from what would be required to support Lombroso's claim. Goring reports that in the general population the death rate from epilepsy is 11 per 1,000 while among criminals it is 26 per 1,000. Clearly the relation between crime and epilepsy is not a markedly close one. The same must be said of crime and insanity in general. A few sensational cases have given the public and even some scientists a distorted view of the true situation.

Instincts and Emotions of Criminals

Unfortunately we have not yet reached the point where we are able to measure satisfactorily the instincts and the emotions. We are, therefore, forced to depend on unsatisfactory data in attempting to discuss such characteristics in criminals. This is freely admitted at the outset. With this limitation clearly in mind, the writer ventures the view that the essential mental differences between criminals and the general population are to be expected in the instincts and emotions. We may reach this conclusion by a process of elimination after ruling out intelligence; or we may reach it on theoretical grounds, if we hold that motivation is the essential psychological aspect of criminality and that motivation depends fundamentally on instincts and emotions. In either case we find our conclusion supported by various students of crime from Lombroso on. Criminality would seem to depend largely on the balance between selfish and social emotions. The criminal is egoistic, self-assertive, vindictive, unsympathetic, inconsiderate of others, anti-social. At times, of course, criminals show considerable sympathy and loyalty to their own group but show their

anti-social feelings towards society as a whole. The worst form of criminal, however, shows little sympathy or loyalty to any group.

It may not be out of place to suggest that the antithesis of criminal character traits is found in the virtues recommended in the teachings of Jesus. We must, of course, distinguish between the teachings of Jesus and the theories of theologians and the practices of churches in such matters.

While a detailed statement of instinctive and emotional traits in criminals is not possible, it seems plausible that adequate measurements would show a deficiency in the emotions on which altruism and sympathy are based and perhaps an excessive development of tendencies related to acquisitiveness, pugnacity, or sex, or to a combination of these.

Summary of Criminal Traits

The general conclusion reached by all really scientific investigators is that there is no criminal type. Rather the criminal shows the same physical and mental characteristics of ordinary citizens, but with differences in degree. Even differences in the degree of development of different traits have not been found to any extent sufficient to afford an adequate description of the criminal class. The suggestion is made that the really important differences will be found in the instincts and emotions when satisfactory measurements of these are available.

The Causes of Crime

The study of the characteristics of criminals is rather unsatisfactory as a basis of stating the cause of crime. The idea that low intelligence is a potent cause of crime is not supported by the facts. In a general way it has been argued that low intelligence makes a person more sug-

gestible and, hence, easier to lead into crime. In this connection, however, it is well to remember that children of ages from about 4 years to 6 years show a strong tendency to contra-suggestibility. After this period suggestibility increases until about the age of 9 years and then decreases until maturity. Suggestibility is greater in girls and women than in boys and men. It is related apparently to self-assertiveness rather than to intelligence. The actual facts would seem to indicate that low intelligence makes for obedience to law rather than the reverse.

Insanity is undoubtedly the cause of some crime, but the total amount of crime due to insanity is relatively small. Insanity will explain more crimes than can be explained by low intelligence, but both together are inadequate to explain more than a small part of the total.

The cause of most crime must apparently be sought in innate and acquired emotional dispositions. These are the most important determiners of character.

Heredity and Crime

Goring made an extensive comparison of the crime records of parents and children and concluded that "the criminal diathesis, revealed by the tendency to be convicted and imprisoned for crime, is inherited at much the same rate as are other physical and mental qualities and pathological conditions in man."[1] If we assume that parents and children are exposed to a uniform environment, and this must have been substantially true of Goring's group, such a conclusion is doubtless justified. However, the writer is unable to accept without reservations such a view. Even though we admit that the criminal diathesis may be inherited in much the same way and to the same degree as other traits, it would at the same time seem necessary to

[1] Charles Goring, *The English Convict: A Statistical Study* (London, Unwin, 1913), p. 368.

admit that environment may determine to a much greater degree whether this diathesis will be expressed in actual criminal acts or not. In case of such a trait as hereditary feeble-mindedness it would not seem to matter greatly whether a child is brought up in a good home in the country or in a vicious home in the crowded section of a large city; in either case feeble-mindedness would appear. In case of criminality, however, it is difficult to believe that a tendency to anti-social conduct would be equally likely to result in actual crime in such different environments.

Fernald, Hayes, and Dawley have tabulated the "defective strains in father, mother, and members of fraternity" for 522 delinquent women. Their findings are as follows:

	Per Cent		*Per Cent*
Alcoholic	21.8	Sexually irregular	15.1
Criminal record	15.9	Suicide	1.7
Epileptic	3.3	Tubercular	18.8
Feeble-minded	4.2	Venereal disease	1.3
Insane	3.3	Wanderer	3.1
Neurotic	4.8	Total with defect	49.0

The last item, "total with defect," is the total number of cases with one or more of the listed defects. In 51 per cent of the cases there was no known defect of the kind listed. In many cases, however, such defects probably existed but were not reported.

An examination of the figures given is sufficient to convince one that there is much more hereditary defect among criminals than among normal individuals. At the same time some of the items listed are of questionable significance in connection with crime. It is especially difficult to accept the tubercular group as having any particular connection with crime. Goring found the death rates of criminals and ordinary citizens from tuberculosis to be almost identical. Since this is the second largest item in the list, its elimination would materially reduce the 49 per cent, though from

the facts given it is impossible to say just how much it would be reduced.

While it is perhaps not safe at the present time to attempt a statement as to the exact extent to which criminality is inherited, it seems evident that heredity does have a very important influence.

Environment and Crime

It is almost inevitable that children with innate criminal tendencies will be brought up in environments of an unfavorable kind. For this reason it is very difficult to separate the influences of inheritance and the influences of environment. And it is not possible, for obvious reasons, to submit the question to experimental test. Under the circumstances it is, therefore, necessary to consider as tentative any conclusions as to the effect of environment on crime.

Sex differences in criminality may be attributed to a considerable extent probably to environmental influences. Men are in general more exposed to temptation to commit crimes of violence and of acquisitiveness. Fernald, Hayes, and Dawley report that only 3 per cent of the women delinquents studied by them had not been gainfully employed. In other words, women who remain out of industry rarely become entangled with the law.

Crime statistics show rather marked fluctuations from time to time. The World War was associated with an increase in crime. Crime varies with the economic cycle. Depression and hard times encourage theft and robbery.

Probably one of the most serious causes of crime is laxity in the enforcement of laws. This in turn depends on public opinion. At the present time in the United States the odds appear to be distinctly in favor of the criminal. He has an excellent chance of not being arrested. If arrested he can usually get bail and if advisable he can disappear and let the bail be forfeited. He may never be tried and if tried

there is an excellent chance of escaping conviction, or if convicted he can usually depend on his lawyers to find some technical defect in the court procedure or at least to get an appeal. If convicted to hang or to be electrocuted there is an excellent chance that the maudlin sentimentality of the community can be enlisted in his behalf and a commutation of sentence or even a pardon secured. If the sentence is only to a few years in the penitentiary, by good conduct

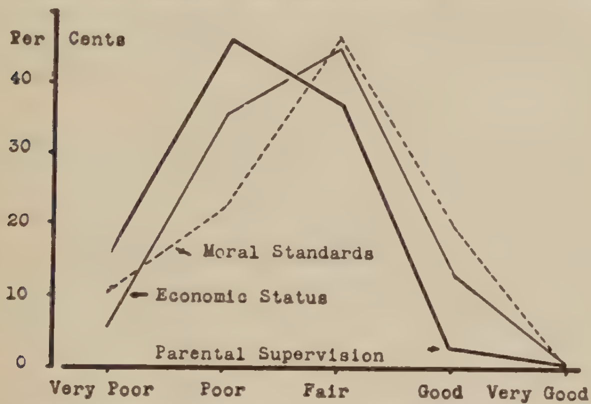

FIG. 43.—RATINGS OF THE MORAL STANDARDS, ECONOMIC CONDITIONS, AND PARENTAL SUPERVISION IN THE HOMES IN WHICH 420 DELINQUENT WOMEN SPENT THEIR CHILDHOOD AND ADOLESCENCE. (Based on data from Fernald, Hayes, and Dawley.)

the criminal will usually escape in half the allotted time if he has a few friends with money. Rarely do we hear of speedy and sufficient punishment of criminals. Where such conditions prevail, is it any wonder that crime increases? Those without particularly strong criminal tendencies may be led into crime if the rewards appear to be great and the chances of punishment slight. If, however, we had an adequate police force and if we handed out summary punishment to criminals, it seems safe to assume that fewer crimes would be committed. Whether the view

is correct or not, many people think today that lax law enforcement is one of the most important causes of crime.

Laxity in law enforcement as a cause of crime applies not only to the activities of the government but also to parental supervision in the home. Figure 42 shows the ratings of the homes of delinquent women by Fernald, Hayes, and Dawley for parental supervision, economic condition, and moral condition. The greatest deficiency is evident in parental supervision. It is worth recalling here that Terman found the homes of his group of superior children particularly strong in this respect.

TABLE III

PERCENTAGE OF CRIMINALS HAVING LOST THEIR PARENTS BY DIFFERENT AGES

Up to Age	Father Dead (Fernald *et al.*)	Mother Dead (Fernald *et al.*)	Mother Dead (Goring)
5	11.8	9.4	7.7
10	18.6	13.5	15.4
15	24.9	19.4	25.2
20	34.7	26.3	35.5

Lack of parental supervision may be due to indifference on the part of the parents, it may be due to homes broken up because of quarrels between the parents, and it may be due to the death of one or both parents. On the latter point it is interesting to compare the results reported by Goring and by Fernald, Hayes, and Dawley on the numbers of criminals losing their parents at particular ages. This is shown in Table III. Just how these figures compare with the general population cannot be stated. We must not overlook the fact that in a large number of cases in the general population the death of one or both parents occurs without any appearance of criminality among the children. At the same time it seems probable that the death of parents

would tend to be injurious to the best development of children.

Healy and Bronner summarize their study of the effects of home influences on delinquency as follows:

> Specifically, if we ruled out the families in which there were such clearly unfortunate features of home life, poverty, great crowding or very insanitary surroundings, extreme parental neglect or extreme lack of parental control, excessive quarreling, alcoholism, obscenity, immorality or criminalism, mother away working, mentally diseased parent in the home, how many had we left? Enumerating the good homes thus by elimination, we found . . . the figures for Boston to be 10.3 per cent, for Chicago 5 per cent, numerically only a small difference. Among 2,000 young repeated offenders, then, there were living under reasonably good conditions for the upbringing of a child, only 7.6 per cent.
>
> We have no other figures showing such high correlation between background conditions and the incidence of delinquency. Where to place a large measure of responsibility, where to direct a strong attack in treatment and for prevention of delinquency stands out with striking clearness.[2]

The only comment the present writer wishes to make on this admirable summary is that in many instances the bad environmental conditions in the home must have been associated with and caused by defective heredity in parents and in children. Improving the environment would be of value but would not always compensate for bad heredity.

In comparing environments we should not overlook the marked differences between rural and congested urban conditions. The rural child and the child in the crowded tenement districts can scarcely be compared as to the relative amounts of temptation to commit crimes. It is inevitable that the latter districts should supply a large number of individuals with anti-social tendencies.

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[2] W. Healy and A. Bronner, *Delinquents and Criminals* (New York, Macmillan, 1926), pp. 128-129.

As another non-hereditary factor in the causation of crime we may mention order of birth. Here again we meet the rather puzzling fact that a disproportionate number of first- and second-born children become criminals. The fact seems clear, but an adequate explanation is lacking.

Among the environmental factors which have been supposed to be of great importance in the causation of crime are alcohol and drugs. A few years ago we were told by reformers that the prohibition of the use of alcohol would empty the jails. The amount of alcohol consumed has probably been materially reduced, but the jails are fuller than ever. In England where prohibition does not exist, there has been a gradual decrease in the number of criminals since the War. Certainly we are not justified in saying that alcohol in itself has much direct effect on crime. Germany and France have much less crime than we have, but both consume much alcohol. The effect of drugs is difficult to estimate, but certainly there is little reason to suppose that drugs in themselves are the cause of any large percentage of our crimes. A more plausible statement is that an excess of criminals take to drugs and thus it naturally happens that many criminals are drug addicts.

Fernald *et al.* report that 53.2 per cent of the delinquent women studied had never used alcohol, 26.2 per cent were moderate users, and 20.6 per cent were excessive users. The drug users were 18.3 per cent of the total. The excessive users of tobacco were 18.8 per cent of the total, while 75.6 per cent had never used tobacco. In earlier times it would probably have been easy to duplicate the figures for the use of alcohol and tobacco among the ordinary population. Only the figures for the use of drugs would seem to be particularly striking. And here, as stated, the use of drugs is probably more a result of crime than its cause. It may, of course, be both. When strong social censure is the result of using tobacco—true in some circles for women—or alcohol

or drugs it is naturally the more anti-social individuals who develop the habit. Those with anti-social tendencies are also more likely to commit crime. The ordinary citizen is usually not dangerous when drunk and the criminal is likely to be a criminal when drunk. If we make allowance for this aspect of the problem, we shall probably have little occasion to consider the use of alcohol as directly and chiefly responsible for crime. It may, however, often be an additional exciting factor.

Prevention of Crime

Prevention naturally implies the removal of causes. If crime is to be reduced or prevented, the causes of crime must be reduced or eliminated. That there are inherited tendencies to crime appears evident. Prevention here must mean the prevention of the increase of criminal stocks. Most criminals come within the clutches of the law relatively early if at all. If, then, they were recognized as dangers to society, steps could be taken to prevent their increase. This might be done either by life imprisonment or by sterilization to prevent reproduction. If an operation of the latter sort were automatically carried out on all cases committed for serious offenses, it would act as a strong deterrent from crime as well as relieve society of the breeding of further individuals of the same stock. When society at large becomes intelligently acquainted with the importance of such a measure, something of the kind will be done. It is the most important step in the direction of crime prevention.

Present methods of handling criminals are calculated to increase rather than to decrease crime. The criminal who is sentenced to a few years in jail and then released is usually worse than when originally committed: he knows that his criminal record will make it very difficult for him to secure a new position; he has associated with criminals and has secured a further education in crime. It is, therefore, a very

natural thing for him to drift back into crime, at which he will now be more expert. What is needed is a policy of reformation, life imprisonment, or execution. There is no place for punishment of a brutalizing character when such punishment is followed by release.

As already pointed out, our legal system will require revision, if we are to deal with crime in a satisfactory way. We have entirely too many laws. Our legislators have been industriously engaged in adding and adding and adding continuously to our laws until not even the lawyers know what the laws are. What is needed is a broad and comprehensive repeal of laws. Then the remaining laws should be rigidly enforced. Entirely too much latitude is at present allowed to judges and to other officials in determining the fate of a criminal. In a particular situation one judge would impose the death penalty while another judge would impose a sentence of life imprisonment, with the result that the prisoner would be later pardoned. Such arbitrary power in the hands of one man savors more of autocracy than of democracy and cannot be reconciled with the psychology of individual differences.

Not only must laws, to be enforceable, represent the common will, but they must not restrict the rights of the individual unless such restriction is essential to the common good. Unless these requirements are met, many good citizens without anti-social tendencies will be led to violate laws and so become technically criminals. When laws are enacted to please noisy minorities, it is not surprising that we find law makers are very often law breakers. If only vital laws were passed, this condition would rarely exist.

The final need, if we are to reduce or prevent crime, is to provide agencies for the better social and moral training of children. The home is the proper place for this, but unfortunately many homes are themselves demoralizing to the child. A certain solution for this problem is not at hand,

but something more could be done in the schools and some benefit would result from adequate playgrounds under proper supervision. The churches, unfortunately, do not reach the particular classes who are most in need of moral influences. Also, the problem is a public one rather than a private and sectarian one. Compulsion will probably be necessary to reach the classes most in need of such help.

Sentimentality and Crime

One of the most serious difficulties at present in the way of crime prevention is the false sentimentality and lack of understanding which inclines to excuse crime if any trace of insanity or mental imbalance is found. The public is not acquainted with the scientific point of view, nor is it possible to make clear to the public the nature of psychological determinism. However, on scientific and philosophic grounds it is just as plausible to commit one criminal to a hospital or institution for the insane as it is to commit another, if the grounds for the commitment are to be "freedom" and "responsibility." It may be argued in all cases that acts are the logical and inevitable outgrowths of antecedent conditions and hence that no criminal is "responsible." The only consistent thing to do is either to dismiss this argument entirely or to apply it in *all* cases. This is no place to discuss the question of the freedom of the will, yet a clearer understanding is necessary as a basis for an intelligent handling of crime. Without attempting a discussion of the matter, the writer submits as a guiding principle the idea that the treatment of criminals be determined by the aim of protecting society from crime and that the idea of responsibility be discarded in determining the treatment of criminals in so far as this responsibility may be supposed to be determined by intelligence or moral insight. The only justification for executing any criminal is to protect society by affording a terrible example to other

criminals. If then, we are to execute at all, there is all the more reason for executing the insane and mentally defective criminals; they cannot be made into desirable citizens. The criminals we execute with greatest assurance are likely to be the ones most nearly normal and hence most capable of reform. We have no consistent policy here, though one is necessary if we are to solve the crime problem. Although this is outside the proper field of the psychology of individual differences, it is within the field of applied psychology to point out the fallacy and inconsistency of the sentimental pleas made for special classes of criminals.

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CHAPTER XVI

INDIVIDUAL DIFFERENCES AND SOCIAL DIFFERENTIATION

Castes and Classes in History

During most of the historical period as we know it, and among most peoples, castes and classes have existed. The king, chief, medicine man, high priest, or other ruler has represented the highest caste. In some cases the most distinguished rulers were proclaimed gods, as in Rome, while even in modern European history some kings claimed to rule by "divine right." At the other extreme of the scale are the slaves, or perhaps the convicted criminals. In between are various castes or classes, depending on the particular society. Orders of nobility exist in many countries, and these are usually hereditary. Below the nobility we find the so-called middle class, really a superior group. Below this middle class we find the mass of the population. Both the middle class and the common people are also often divided rather sharply into occupational groups with a distinct class consciousness. This is particularly true, for example, in England and in Germany.

One of the most rigid caste systems in existence today is in India. Here the highest caste is the Brahman, or priestly. Next is the Kshatriya, or warrior. Next is the Vaisya, or mercantile and agricultural. Last is the Sudra, or artisan and laboring. The first three castes are composed primarily of invading Aryans, while the lowest caste is composed of conquered natives. Aside from this general division, many other castes have been formed on the basis of occupations,

intermarriages, migrations, etc. The result is a rigid and cumbersome system of rules of conduct regulating social intercourse, and, to a considerable extent, also many other phases of activity.

In America we are rather inclined to pride ourselves that we are democratic, that this is a country of freedom and equality. In fact, the very beginning of our government is associated with a declaration of equality. Some, of course, deny that this was meant to be taken literally to mean intellectual equality, but a review of the historical background of the doctrine as it developed through the Reformation and the Enlightenment shows that it was rather literally understood—at least by many. On the other hand many colonists were opposed to the declarations of equality, because they found the idea of class differences much to their liking. This is true of many who were due to lose their superior position if the colonies won their independence.

On the whole, America has been more nearly free probably from class distinctions than other countries, but that has been due to the conditions of pioneer life. The degree of democratic equality has been rather directly in proportion to the newness of a settlement. As a settlement has become old, class distinctions have developed. In the West the family trees are still young; in the East and South where the settlers have been for several generations, family is a matter of great consequence. With increase in age we find increasing segregation and differentiation in the social structure. This is the normal process of evolution.

Consciousness of Kind

Giddings has emphasized the importance of *consciousness of kind* as a determiner of social action. However we may explain this psychologically, there can be no doubt that it works. Similarity in amount of wealth is one powerful factor in separating society into groups. This operates

naturally and powerfully in determining place of residence in cities. It is economic in part, but it is also psychological. Similarity of occupation is another strong factor in determining the organization of social groups. Laboring men prefer the company of their own kind; the same holds for professional men; and so for other groups. Similarities in interests tend likewise to bring people together. Athletics, dancing, card playing, music, painting, religion, and other activities are responsible for many groups.

The desire for congenial associations together with social distinction leads to the formation of clubs, of honor societies, of groups descended from certain historical groups, etc.

Social Differentiation and Marriage Selection

One of the most important results of this social differentiation into groups is its effect on marriage selection. Association is one of the most powerful determiners of marriage. Young men and women may cast admiring glances at people they see on the streets, but they usually marry the people they meet in their own social groups. To marry outside of one's social group is neither easy nor as a rule likely to meet with social approval. To be sure, those with sufficient ambition and ability may rise to a higher group, or those with too little of these qualities may drop to a lower one. The effect of this is simply to increase the degree of differentiation into groups. It removes those who differ most from the group.

Occupation and Intelligence

That social groups exist will be admitted by all. That these groups show significant variations in intelligence will not be accepted so readily by many. On this point, however, we are supplied with a number of experimental studies. The largest and most important is the comparison of occupations made on the basis of the Army tests. Table IV

TABLE IV

MEDIAN ARMY ALPHA SCORES FOR DIFFERENT OCCUPATIONAL GROUPS BASED ON TABLE 377 OF THE ARMY REPORT

Number of Cases	Occupation	Median Raw Alpha Score
983	Laborer	46.7
5,126	Farmer	48.3
595	General Miner	48.9
143	Tailor	53.3
275	Barber	54.6
157	Bricklayer	57.9
294	Baker	58.7
531	Painter	58.7
657	General Carpenter	59.8
629	Locomotive Fireman	60.1
275	General Blacksmith	61.2
370	Butcher	61.4
1,065	General Machinist	62.8
722	Brakeman	63.0
85	Railroad Conductor	64.0
48	Locomotive Engineer	64.0
224	Plumber	66.2
190	Auto Assembler	68.1
102	Detective and Policeman	69.3
482	General Electrician	80.8
289	Band Musician	81.9
255	Telegrapher	84.8
83	Photographer	85.7
1,565	General Clerk	95.8
450	Bookkeeper	100.9
40	Mechanical Engineer	109.7
400	Stenographer and Typist	115.0
53	Civil Engineer	116.8
201	Accountant	117.9

shows the median scores made by a number of different groups. These range, it will be noted, from the common laborers at the low end of the scale to the accountants at the upper end. There is, of course, much overlapping between the various groups. Some common laborers are very intelligent. This holds for all of the groups with low averages.

On the other hand we do not find any engineer officers with a low degree of intelligence. The training they have had has been sufficient to eliminate any of even average mentality. The same holds, but to a lesser extent, for the other occupations at the top of the list. Occupation groups towards the middle of the list will contain all grades of intelligence, though most members of the group will be near the average.

The Army tests were given to adults, mostly young, who were actually engaged in particular occupations. Very similar results, however, have been secured by studies made on children classified by the occupation of their parents. Studies along this line are rather numerous, but a few will be given to illustrate the results. Duff and Thomson (1923) tested 13,419 children, 11 and 12 years of age, in England and classified these according to parental occupation. The average I.Q. for children of the professional classes was 112.2 and for laborers 96. Other occupational groups were between these. Pressey and Ralston (1919) tested all the available children from 10 to 14 years of age in a town of 12,000, these being 548 in number, and found that 85 per cent of the children of professional men were above the median of the total group in comparison with 68 per cent of the children of executives, 41 per cent of the children of artisans, and 39 per cent of the children of laborers. Dexter (1923) tested children in grades 1 to 8 in 13 ward schools in Madison, Wisconsin, and determined the average scores for occupational groups. The correlation between this determination and the results of the Army tests was found to be .79. Haggerty and Nash (1924) studied the intelligence of children according to occupation of parents and found in the elementary school the same general results as those already described. In the high school the differences were not pronounced, but great differences were found in the amount of selection occurring before high school. A much

smaller per cent of the children of the laboring classes attend high school. A rather large difference was found between the children of miners and those of lawyers. None of the former group attained the median attained by the latter group. Generally speaking, there is, of course, much overlapping between the various groups.

Place of Residence and Intelligence

If there are differences in intelligence according to occupation, it would quite naturally follow that differences in intelligence would be found between different sections of the same city, between city and country, between different

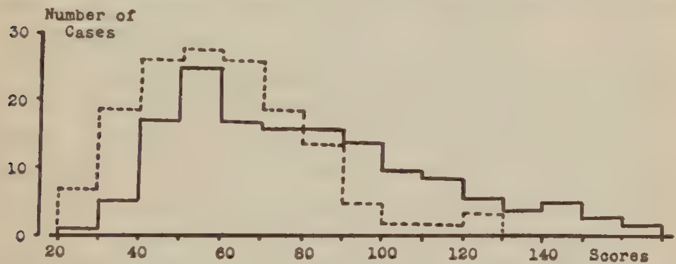

FIG. 44.—THE DISTRIBUTION OF THE INTELLIGENCE TEST SCORES OF 87 SEVENTH GRADE CHILDREN FROM FACTORY DISTRICTS (DRAWN WITH BROKEN LINE) COMPARED WITH THE DISTRIBUTION OF THE SCORES OF 150 SEVENTH GRADE CHILDREN LARGELY FROM BETTER RESIDENTIAL DISTRICTS (DRAWN WITH SOLID LINE).

To make the distributions more directly comparable the orddinates for the factory group have been multiplied by 1.72, thus raising the number of cases to 150. The mean score of the factory group is 60.6 and for the other group it is 81.5.

sections of the state, and even between different states and the larger geographical divisions. That this inference is correct is shown by the results of a number of investigations. Myers (1921), for example, found such a difference between three social groups in Cleveland drawn from different residence districts. The writer compared the seventh grade in

three schools in factory districts with the seventh grade in a centralized school drawing on a more representative population in Knoxville, Tennessee, and found a considerable difference between the two groups. The distributions are shown in Figure 44. The most conspicuous feature of the chart is the great difference at the upper end of the two distribution curves. Few children of superior ability are found in the factory districts.

The rural districts have been compared with urban districts by Pressey and Thomas (1919 and 1920). They tested children aged 6 to 8 years and 10 to 14 years in a poor rural district and in a good rural district and compared them with the normal for those ages. Those from the poorer district made lower scores than those from the better district, and both made lower scores than the average. Only 22 per cent of the 6-to-8-year-old children equaled or exceeded the median for their age, and only 20 per cent of the 10-to-14-year group equaled or exceeded the median for their group. The two results thus confirm each other. The country children tested about 1½ years below the average for city children. This general result is supported by Book's survey of the intelligence of high-school seniors in Indiana, though a high-school survey cannot show with much accuracy the differences between communities because of the elimination which takes place before the end of the high-school course, this being the time considered in Book's survey.

A comparison of the intelligence of the different states and of the different sections of the country is afforded by the Army tests. A preliminary comparison of these results has been made by Alexander (1922), using the results on Army Alpha as a basis. Since those who were illiterate took Beta, the scores for the lowest states are probably too high rather than too low. The results, it should be stated, do not include the Negro population. Oregon with an average score of

79.9 was highest and Mississippi with a score of 41.2 was lowest, the highest state thus showing an absolute score nearly double that of the lowest state. Due to the nature of the test, however, this does *not* mean that the average Oregonian is twice as intelligent as the average Mississippian. In terms of the Stanford Revision of the Binet Test the corresponding mental ages would be about 15.1 and 12.6 years. There is, then, an average difference of about 2.5 years of Binet mental age. On the whole the Pacific states were highest, then came a mixture of Western and Eastern states, with the Southern states as a rule near the bottom of the list.

Alexander has compared this list of states with a number of other state rankings. When compared with the ranking of the states in the number of eminent men as worked out by Davies for 1912, the correlation is $.79 \pm .05$. Evidently, then, there is much in common between the factors responsible for the production of eminent men and those responsible for the production of high average scores on the Alpha. Comparisons with economic conditions, with literacy, and with condition of the school systems also yield high correlations. This, of course, raises the question of which is cause and which is result. However, from the results of comparisons of the intelligence both of parents and of their children according to occupation, and from the comparisons in addition of rural and city children, it would seem to follow as a matter of necessity that a state which is essentially rural and agricultural would have a lower average than a state which has a large urban population. It would thus seem inevitable that Massachusetts or Pennsylvania or New York would be higher than Louisiana or Arkansas or Mississippi. There is, however, a greater difficulty in explaining the difference between the Pacific states and some others. This, the writer believes, depends on some other factors to which we shall now turn.

Movements of Population, Migrations

The average school boy is acquainted with the fact that the different colonies were settled by people who came to America for different reasons. New England was settled largely by people in search of religious and political liberty. This in itself implies a considerable degree of intelligence and intellectual independence. It is not, therefore, surprising that this section of the country should have begun and maintained a superior system of schools, and that their colleges should still be among the best. With this tradition of intellectual superiority and encouragement of learning, it is but natural that these states have attracted from other states a considerable number of their most intelligent citizens. New York started as a colony of traders and is today the leading business center of the country. It has drawn the best business brains from the other states. Virginia, settled originally by adventurers and gold hunters, became essentially a place of rural estates and plantations somewhat after the English system. The upper-class landlords had inherited, socially speaking, an interest in politics and government, and Virginia became justly famous for her great public men. But men were also needed to work the plantations and this resulted not only in the introduction of African slaves but also in the bringing in of many whites of relatively low grade. The English Government followed for some time the practice of sending to this country its debtors, paupers, and minor criminals to work on the plantations. Farther south a whole colony was founded with such settlers. After the separation of the colonies from the mother country this undesirable tide of immigration was turned to Australia, which was originally a penal settlement. It would take us too far afield to follow out in detail the changes in American population, but enough has been said to suggest the importance of considering the classes of population which have migrated to different states.

Due to differences in soils and climate, the North became a shipping, trading, manufacturing, and mining country while the South became an agricultural country. This difference still remains in large measure.

Studies of Northern and Southern Negroes have shown clearly that the abler and more intelligent Negroes have migrated northward, with the result that the Northern Negroes have a much higher average than the Southern ones. This fact has several interesting features, but just here we are interested in only one: in an unsatisfactory environment which cannot be changed by individual effort it is the more intelligent and energetic who migrate. The less intelligent and energetic accept the situation. The same principle applies to whites as well as to Negroes.

The increasing of the urban population at the expense of the rural population in numbers has at the same time brought about a change in relative levels of intelligence. The more energetic and intelligent in the country have migrated to the city—not, of course, *all* of the most intelligent and energetic in the country but a disproportionate part of them. This is rather generally accepted as true by students of the problem. In quite the same way a disproportionate part of the intelligent and energetic part of the Southern population has migrated from the Southern farms to Northern cities and to Western states. The lazy, the shiftless, and the unintelligent have remained near where they settled—in Massachusetts, in New Jersey, in Virginia, in Georgia, and in other older states. For this reason largely, the writer believes, the Western states have shown up well in the Army tests. They have been settled by people with enough imagination to find conditions in the more eastern states unsatisfactory and they have had enough energy and resolution to make an attempt to improve their condition. The call of "Westward Ho!" has not been strong enough to reach the lazy and the stupid. The progressive-

ness of the West is the logical result of the restlessness and enterprise of its settlers. The East, because of its intellectual prestige, its universities, and other centers of culture and learning, retains a large proportion of the most intelligent members of the population; but it also has a large number of the lowest-grade members of the race. There is, then, nothing strange or startling about the results of the Army tests as far as the comparative rankings of states are concerned. They are what one might reasonably infer.

Adaptation of Organism and Environment

Adaptation to environment is to a certain degree essential to the life of all organisms, and in the higher animals, especially man, satisfactory adaptation requires an adequate adjustment between the opportunities of the environment and the desires of the individual. In the long process of evolution, adaptation has to a considerable extent been by a process of bodily change, but with that we are not here concerned. Adaptation also takes place by means of physical and mental adjustment. An example of this is the change in sensitivity to heat and cold which we regularly experience from one summer to the next. Another example is the becoming habituated to the noise of a city so that it does not interfere with mental work or with sleep. Other examples of adaptation are found in the little deceptions which form such an essential part of social tact. Or again we have an example of adaptation in the case of the man who keeps on working at a disagreeable position, or in the case of a woman who continues to live with a drunken and brutal husband. But while adaptation takes place and is a necessary part of existence and may in certain ways be considered an essential mark of intelligence, there are clearly limits to which the process may be carried.

What the individual seeks is not to change himself or his behavior as a means to adaptation but rather to change his

environment. The greater the energy and intelligence of the individual, the greater this tendency. Now, in effect, the environment may be changed in either of two ways: first, by modifying the environment at hand, as by building a house and heating it if the weather is too cold, or second, by migrating to an environment that is satisfactory, as by moving from a cold to a warm climate as some birds do from season to season. Within limits the modification of the environment is the easier and preferable process, but there are very distinct limits to which it can be successfully carried. The boy or girl in the rural districts who has a great liking for social life is confronted with the practical impossibility of having very much of it at home. The only way to secure it is to migrate. So it is with many things: the discrepancy between what is desired and what is possible in a given environment may be so great that the individual leaves the environment for one that offers with less effort the objectives sought. Whenever, therefore, any considerable discrepancy exists between the characteristics of the individual and his environment, we may reasonably expect that he will tend to make some effort to adjust the difference. This, in the writer's opinion, is the fundamental basis of the groupings of individuals in occupations and in residential and other geographical zones in such a way that differences in intelligence are found. It is the foundation of castes and classes.

The argument here may be reduced to three main propositions: first, that abilities vary and are distributed according to the normal curve; second, that jobs and positions vary greatly in their requirements of abilities for successful performance; and third, that in general the individual prefers the position in life which is adapted to him rather than the one to which he might by extraordinary effort adapt himself. In social relations somewhat the same kind of things may be said about differences in temperaments and

interests. The third principle is subject to some apparent exceptions, but in general it seems to hold. Certainly most people like to succeed in their undertakings and very few are conspicuous for their zeal in working after hours. On such a basis, then, men of different abilities will tend naturally to gravitate into occupations to which they are suited. If they attempt an occupation which is too difficult, they will quit and search for an easier one. If they get into a too easy position, they will find it monotonous and unstimulating and will prefer something more nearly adjusted to their abilities and interests. The problem is of course complex, but this represents one of its essential phases.

In a somewhat similar way in social affairs it is much easier to get along peacefully and enjoyably with other people of similar tastes, moral standards, and abilities. Lovers and opponents of garlic do not dine happily together. Puritans and devotees of Bacchus will not find each other's company and ideas agreeable. Nor will philosophers and fools often be found walking together. Similarity is the basis of congeniality. This is well shown in the case of identical twins. The differentiation of society into classes is thus a necessary result of individual differences. This is emphasized and perpetuated by the fact, already referred to, that marriage selection is usually within the group of similar social and economic standing.

Among animals where intelligence is not an important factor and where matings are controlled mostly by chance and instinctive physical attraction, a more homogeneous group may be expected. Variability will be relatively small. Among primitive peoples where family ties are loose and where mating is again largely a matter of chance and instinctive physical attraction, somewhat the same result may be expected as in lower animals. Among more intelligent and civilized men, however, the expression of the sex

tendency has been decidedly curbed and restricted and monogamy has tended to be the more general practice. This tends definitely to reduce promiscuous matings and to limit them more nearly to individuals of similar social status. Thus the total population passes from a relatively homogeneous condition to a heterogeneous one in which it comes to consist of a large number of more or less separate groups. The older and the more established the civilization, the more sharply these groups may be expected to be differentiated.

Rates of Increase of Different Classes of the Population

Under colonial conditions large families were almost the rule. This was particularly true on the frontiers. With successive generations, however, the size of the average family has been reduced. This would not in itself perhaps be a cause for concern if the reductions in all classes of the population had been proportional. But they have not been. The greatest reduction has taken place in the size of the families of the most intelligent, while the least intelligent have continued to raise large families. The graduates of some of our leading colleges for men and for women do not have enough children to replace themselves.

Accurate figures are, of course, impossible as to the exact extent to which each quarter of the population is replacing itself. Nothing more than a probable estimate can be given. From the figures at hand, however, it seems probable that the lower half of the present population is producing three-quarters of the next generation. The final result of such a change in the relative rates of reproduction of the different classes of the population can mean only one thing: a lowering of the average intelligence of the population. No amount of effort directed at the improvement of our educational system can prevent such a result, if those with less than average intelligence produce a

majority of the next generation. If we were surprised and shocked at the average showing made by our soldiers on the Army tests, we may as well prepare ourselves for a still poorer showing in the future.

Important evidence of the relation between intelligence and size of family has been published by Lentz (1927). In a group of 4,330 cases he finds that the only children have an average I.Q. of 107.9 while the children from families of 13 and more children have an average I.Q. of 79.9. Moreover, the figures for intermediate families show rather regular declines in average I.Q.'s. The composite correlation between intelligence and family size for the 4,330 cases is — .304. ± .010.

The reasons for this change in the state of affairs are rather complex, but several suggestions may be made. The increased development of scientific medicine has greatly reduced the mortality rates, especially for infants, with the result that while formerly a large number of the lower classes died before attaining maturity, they now survive to raise families. This increase in medical knowledge has not to the same degree affected the upper classes, because they have had better care and better food and have never shown the high death rate characteristic of the poorer classes. Modern charity has furthermore tended to make it easier for the poorer classes to increase and multiply. In some cases families have continued to be supported by charity although the family continued rapidly to increase in size.

A number of factors cause the upper classes to show a lower rate of increase. On the whole because of greater ambition and other reasons they marry later, and the age of marriage has some relation to the number of children. There is also a greater amount of voluntary control of the size of the family. This is done in part because of the desire to give the children a greater opportunity, and in

part it is due doubtless to the unwillingness to give up outside activities to the extent necessary to raise a large family. Another factor which operates to some extent is the difference in physical condition of the upper and lower classes. The lower classes are ordinarily forced to do a considerable amount of manual labor. This applies to the women as well as to the men. There can be no reasonable doubt that such exercise tends on the whole to make them more able to bear children. The women of the upper classes, on the other hand, too often lead lives of ease and luxury and take only a minimum of exercise. Such a method of living reduces them to a physical condition which is unfavorable to the bearing of children. The body requires a considerable amount of exercise for its normal functioning, and when it does not get it a decrease in functional efficiency is the necessary result.

Eugenics

Eugenics has for its aim the improvement of the race by better regulation of marriage and the size of families. Mental deficiency, insanity, and even criminality are in many instances due to a great extent to heredity. If, then, the low-grade mental defectives, the insane, and the constitutional criminals can be prevented from breeding, we may reasonably expect some reduction in such cases. On scientific grounds one might also recommend the education of the poorer classes to the need of regulating the size of their families, but due to the moral aspects of the problem it seems evident that this will require a considerable change in public sentiment before it will be practically possible. On the other side, the upper classes need to be educated to the importance of having families which will be at least large enough to replace themselves. Earlier marriage on their part is a desirable though perhaps not an absolutely essential requirement. Physical training and

education on the importance of physical welfare are also necessary, if the upper classes are to maintain their present position. A much broader biological perspective is seriously needed in dealing with the whole problem of marriage.

Objectors to the program of the eugenicists insist that at present our knowledge of heredity is too limited to justify us in attempting to carry out any practical program of regulation of marriage. The really serious difficulty, however, is not so much the defects in our knowledge as the refusal or the inability on the part of the general population to view such problems in a scientific light. That we have too many low-grade defectives and too many insane and that we could reduce both of these by selective breeding may be regarded as certain, but on the question of just how many people of each grade of intelligence are needed it is not possible to give a definite answer. There is a place in our social and economic system for many classes of intelligence and ability, and each class is dependent on the efforts of the other classes.

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CHAPTER XVII

THE ORGANIZATION OF MIND

Special versus General Abilities

Thus far, as outlined in Chapter III, we have discussed abilities in terms of variations in single traits, except as convenience may have made it easier to discuss complex traits. However, even in discussing complex traits we have assumed that they were subject to analysis into a number of definite and more or less distinct abilities and tendencies. This point of view, it should be clearly understood, is in sharp contrast to the idea that memory or attention or reasoning power functions as a unit. Rather it has been pointed out that such a term as *memory* really covers a complex group of distinct abilities, as auditory memory for digits, visual memory for colors, auditory memory for pitches, kinæsthetic memory for movements, etc.; and the point has been made that an individual may be above the average in one of these memories and below the average in others. This has been emphasized especially in connection with references to the doctrine of formal discipline as an erroneous view of the effect of training on individual differences.

How Are Specific Abilities Related?

There remains a very important theoretical and practical question as to how these specific abilities may be related. In other words, if we know the strength of one or several specific traits in an individual, what can we predict as to the probable strength of other unmeasured traits in the same

individual? There are here three possible forms of fundamental relationship: (1) There may be no connection at all between the amounts of different traits found in the same individual, a knowledge of the strength of one or more traits may give no indication at all as to the probable strength of others. (2) Traits may be closely related in the sense that if one is strong all others will tend to be strong, *i.e.*, there may be a tendency for strength or weakness in traits to be positively correlated. Or (3) traits may be so related that if certain ones are strong, others will be weak; weakness in one direction may be compensated by strength in another direction, *i.e.*, the general relation between traits may be that of negative correlation.

To some it seems that the view here supported would lead necessarily to the first view, that no relation at all would be found between different traits. Such, however, is not the case. At any rate, the question is one of fact to be settled by the results of observations and measurements rather than by argument. To the evidence then we shall presently turn; but, in order to show more clearly the significance of the problem, some further discussion of the popular and scientific views on the matter may be presented.

Before the development of scientific psychology there was a disposition to consider the intellect as a unit which would, of course, deal about equally well with all kinds of problems. Such differences as were found in achievement were explained almost wholly on the basis of differences in interest and effort. This passed, however, with the passing of the faculty psychology.

When a beginning was made on the study of individual differences, it was only natural that extreme and unusual cases should be the first noticed. Now it happens that the most unusual cases are those of the idiots-savants or savants-idiots variety, *i.e.*, cases showing very high ability along some lines with very low ability along other lines.

By a process of hasty generalization it is assumed that these cases represent the typical situation and that strength or weakness in one direction is generally associated with the opposite in other directions. This conclusion rests on the tacit assumption that the amount of energy or ability in all individuals is the same. If, then, an excessive amount is drawn off in one direction it must leave inferiority in other directions. There is, however, no justification for this assumption.

The possible examples of the application of the idea of compensation are numerous, but we shall content ourselves with a few of the more common ones. Those good in one kind of sensory imagery are supposed to be poor in others. Rapid learners are supposed to be poor retainers. People with great power of concentration are supposed to have narrow interests. Great intellects are supposed to be associated with inferior physiques. Great power of abstract thinking is supposed to be associated with inferior ability to deal with practical matters. Great artistic ability is supposed to be an indication of inferiority in other matters. Genius and mental deficiency are supposed to be closely related. Football players are supposed to be intellectually stupid.

Before taking up the evidence on the above problems it is necessary to review here certain facts regarding the significance of correlations.

CORRELATIONS IN TRAITS

The Interpretation of Correlation Statistics

In Chapter IV we have pointed out that correlations may vary between -1.00 and $+1.00$, the former figure meaning perfect negative correlation and the latter figure meaning perfect positive correlation. In practice it is found that correlations rarely reach these extremes, though they

more often reach nearly to the positive extreme. In determining the significance of a correlation it is necessary to consider the size of its probable error. We can be reasonably sure only that the true correlation lies between the limits of 4 times the probable error above and below the observed value. Small probable errors are then necessary, if we are to know with any certainty how close the relationship between two variables is. Usually this means that the correlation must be based on a large number of cases. To avoid misunderstanding we must also consider the sources of error in the interpretation of correlations.

If correlations are to be accurate, it is necessary, in the first place, that the values which are correlated shall be accurate—and they seldom are. Even with a perfect measuring instrument and a well trained experimenter a single test or measure made on a single day will not ordinarily give accurate results. Due to uncontrolled factors it is ordinarily necessary to make a number of measurements at different times, and then take the average of these measurements as the true value. If this is not done, the correlation resulting from the figures will be too low or, in other words, will be *attenuated.* In some cases the true correlation may be double the correlation as found on the basis of single measurements, and, since this factor has not been generally recognized, many published correlations suffer from attenuation. This makes it impossible to compare with any certainty many of the published results.

In addition to attenuation due to too few measurements there is often a serious error due to the instrument itself. Two successive measures with the same instrument or test may not give the same result. The extent to which a test agrees with itself is known as its *reliability.* Not infrequently the reliability of a test will be as low as .60, sometimes much lower. In particular cases the agreement may be very low, or even negative. There is also the ques-

tion as to whether the test measures what it purports to measure; *i.e.*, is it valid? This is particularly true when several tests are used to measure the same thing and the results are compared. The tests may measure rather different things.

If the foregoing conditions are satisfactorily met, a correlation may be relatively meaningless because of the limited number of cases. This is supposed to be allowed for by the probable error; but, as a matter of fact, when a limited number of cases are considered, the probable error may be relatively meaningless. In a recent class experiment in statistics the writer took an alphabetical list of freshmen and found by the method of unlike signs the correlations between two tests of a group test for successive groups of 20 freshmen. Under such conditions the correlations ranged from —.20 to +.80. For the entire group the correlation was about +.50. This is sufficient to show the dangers attached to the use of small groups in determining correlations. Yet it is not unusual to find correlations published by reputable psychologists in which only 10 or 15 subjects have been measured. Results on such limited groups may be worse than worthless.

A still further source of error in the interpretation of correlations is found in failure to allow for differences in the heterogeneity of the groups compared. If, for example, two tests are given to a group of fourth-grade children and the correlation between the tests is determined and then the same two tests are given to grades 3 to 8 inclusive and the correlation again determined, the second correlation will be considerably higher than the first and may be twice as high. This is because the size of the correlation is determined in part by the degree of dispersion or spreading of the data, and so it naturally happens that data based on a single age will vary less than data based on several ages.

The final source of differences in correlations which needs to be mentioned here is the fact that there are numerous methods of calculating correlations. When the same data are treated by different methods, the results are not uniform. The short and easy methods of determining correlation are especially subject to variation in this respect and so should not be used ordinarily for important work.

The purpose of the foregoing discussion is not to leave the impression that correlations are necessarily of doubtful value; it is desired rather to show that to secure results of value it is necessary to control and limit the number of variables which enter into the final result. The purpose of an ordinary correlation is to compare *two* variables. If, then, it happens that instead of two variables there are five, it must be evident that the requirements of scientific method have not been met. It is possible to secure correlations of considerable accuracy and value, but to do so a careful regulation of conditions is necessary. And when we are comparing correlations, it is essential that the correlations be obtained from measurements secured under similar conditions.

The Evidence for Correlation

In our study of superiority and genius we have already found that there is a strong tendency for general intellectual superiority to be associated with superiority along other lines. Terman's studies of superior children leave no room for doubt on this point. Superior children *tend* to be above the average along *all* desirable lines. They are physically somewhat above the average. They show better emotional control than the average. Their social traits are somewhat better than the average. They are more likely than the average to possess good musical and artistic ability. The writer would add that they are also above the average in personal appearance and beauty. The

studies of genius by Galton, by Cattell, and by others do not afford a basis for holding that men and women of genius are generally inferior to the average in other respects. Of course as a matter of mathematical probability we cannot reasonably expect that a man who is a genius in mathematics will also be a physical giant or a musical composer of the first rank. But we can expect that he will be above the average in those respects.

Studies of mental defectives point to similar conclusions. The feeble-minded are in general below the average in physical traits. Their emotions are probably weaker and are undoubtedly less controlled. In social development they are inferior. In mechanical ability or in artistic ability they are again inferior to the average. In no single desirable trait has it been established that mental defectives as a class are superior to the average.

The studies of both superiority and mental deficiency then show that traits are positively correlated. They show compensation or negative correlation only in exceptional cases.

When we turn from these general comparisons of groups of extreme deviations to a consideration of correlations between more specific capacities in more nearly average subjects, we find a considerable array of results available; but, due to the difficulties above enumerated, there are few results in the literature of correlations that are satisfactory for comparison. A statistically minded student might find here an excellent problem if he were to take the many results and attempt to reduce them to a comparative basis and determine reliable standards for the average relation between different traits. Comparisons of instincts, emotions, and other traits related to the affective and conative aspects of character are not possible on a satisfactory basis at present because of the lack of suitable methods of measurement. Such results as are available are very crude.

For the simpler motor capacities and the sensory and intellectual capacities we have, however, somewhat better results.

Experimental Studies of Correlations

Of the many studies of correlations between traits we shall confine ourselves to a consideration of three: one by Pyle, one by Abelson, and one made by Yerkes and reported by Thorndike.

TABLE V

CORRELATIONS BETWEEN DIFFERENT CAPACITIES AS REPORTED BY PYLE (1913)

Numbers at top of columns refer to tests listed at the left after the same numbers.

	1	2	3	4	5	6	7
1. Cancellation	..	.02	.07	.16	.02	—.27	.00
2. Substitution	.02	(.70)	.13	.24	.23	.37	.15
3. Invention	.07	.13	(.91)	.25	.16	—.22	.25
4. Ink Blots	.16	.24	.25	(.42)	.49	—.01	.12
5. Association	.02	.23	.16	.49	..	.03	—.05
6. Logical Memory..	—.27	.37	—.22	—.01	.03	(.44)	—.07
7. Rote Memory	.00	.15	.25	.12	—.05	—.07	

Pyle's Results.—In *The Examination of School Children* Pyle reports a series of correlations between seven tests and from these Table V has been constructed. The tests on which the correlations were based may be described briefly as follows:

Cancellation: this consisted in crossing out as rapidly as possible the *a*'s on a page consisting of the letters of the alphabet arranged in irregular order.

Substitution: this required the association of symbols and digits and the substitution of the latter for the former.

Invention: this consisted in making as many words as possible within a given time limit using only certain given letters, as *a, e, i, r, l, p*.

Ink Blots: associations were to be made to a series of ink blots within a given time.

Association: this included free association and such controlled association tests as the opposites, genus-species, and part-whole tests.

Logical Memory: this consisted in repeating as much as possible of a passage which was heard.

Rote Memory: this required the memorizing of lists of concrete and abstract words arranged in irregular order.

A study of the table shows that the correlations range from —.27 to .49. Most of the values are near .00, or are slightly above. In this case, however, the probable errors of the correlations are not given and we have no great certainty as to what the true correlations between these tests would be. At the same time, the results show rather certainly that no great amount of relationship existed between the traits in question. We shall return later to a further consideration of these figures.

Abelson's Study.—A group of 88 girls and 43 boys who were classed as high-grade defectives or as low-grade normals were given a series of tests by Abelson. This work was very carefully done. The tests used were shown to be of high reliability and every child was given each test twice in order to be certain that the measurements were accurate. These results are, therefore, decidedly superior to those reported by many investigators. The correlations reported are based on 9 tests to which have been added 3 estimates of ability made by the teachers of the pupils in question. The tests made may be briefly described as follows:

Crossing Out Rings: lines were to be drawn as rapidly as possible through each of a series of rings in an irregular line.

Memory for Names: a test of the immediate memory of monosyllabic names of common objects.

Crossing Out Dots: lines of dots in groups of 3, 4, and 5 were given and the groups of 4 dots were to be crossed out as quickly as possible.

Tapping: taps with a pointed instrument were made as rapidly as possible within a square with sides of about 3 inches.

Discrimination of Length: this required the determination as to which of 55 pairs of lines was the longer.

Memory for Commissions: the child was told to do certain more or less complex series of acts and tested on accuracy of performance.

Geometrical Figures: using certain geometrical figures as a basis the child was told to carry out certain directions such as pointing in certain figures and not in others, the figures being covered while the directions were given.

Interpretation of Pictures: eight pictures were shown and the child was asked to tell what each meant.

Memory for Sentences: sentences of different lengths were read to the children and they were required to repeat them after the experimenter had finished the reading.

The estimates of ability considerd by Abelson were of "Reading Ability," "Arithmetical Ability," and "Imputed 'Practical Intelligence'." These were made by the teachers by ranking the pupils in order. The reliability and validity of such estimates is unknown but is probably above what would be commonly found in the average school. At the same time such estimates are very likely to be unduly influenced by purely personal considerations as opposed to scholastic performances.

The results of Abelson's study are shown in part in Table VI. In the original study the results are shown separately for girls and for boys and probable errors are given in all cases. For our purposes, however, it has seemed best to combine the results in one table and to omit the probable errors, though a few of these will be given later.

A study of the table shows that the correlations range from —.22 to .74. The central tendency is around .30. This would be considered a low correlation.

Of particular interest in this connection is the difference between the correlations obtained on the group of 88 girls and the ones obtained on the 43 boys. To some slight

TABLE VI

Correlations between Different Abilities as Reported by Abelson (1911)

Decimals have been omitted. Numbers at top of columns refer to tests listed at the left after the same numbers. Roman type is for girls, *Italic* for boys.

	1	2	3	4	5	6	7	8	9	10	11	12
1. Crossing Out Rings..	90 *94*	17 *–22*	47 *65*	42 *46*	42 *31*	30 *–15*	32 *07*	26 *27*	21 *–02*	27 *41*	34 *02*	43 *04*
2. Memory for Names.	17 *–22*	74 *81*	18 *06*	30 *–08*	22 *18*	34 *38*	13 *52*	33 *30*	42 *66*	24 *20*	30 *32*	18 *19*
3. Crossing Out Dots..	47 *65*	18 *06*	94 *97*	21 *32*	22 *46*	31 *04*	45 *17*	25 *15*	26 *21*	15 *40*	30 *39*	33 *28*
4. Tapping	42 *46*	30 *–08*	21 *32*	92 *91*	37 *38*	14 *38*	33 *07*	61 *25*	27 *20*	26 *37*	29 *–11*	42 *28*
5. Discrimination of Length ....,.	42 *31*	22 *18*	22 *46*	37 *38*	84 *76*	43 *34*	21 *21*	26 *21*	32 *17*	20 *11*	26 *20*	35 *47*
6. Memory for Commissions	30 *–15*	34 *38*	31 *04*	14 *38*	43 *34*	73 *70*	31 *56*	30 *22*	50 *38*	37 *41*	41 *10*	52 *24*
7. Geometric Figure (Directions)	32 *07*	13 *52*	45 *17*	33 *07*	21 *21*	31 *56*	80 *78*	42 *36*	43 *39*	01 *20*	32 *30*	43 *32*
8. Interpretation of Pictures	26 *27*	33 *30*	25 *15*	61 *25*	26 *21*	30 *22*	42 *36*	81 *80*	49 *36*	00 *19*	30 *14*	39 *52*
9. Memory for Sentences	21 *02*	42 *66*	26 *21*	27 *20*	32 *17*	50 *38*	43 *39*	49 *36*	78 *79*	13 *20*	16 *41*	45 *18*
10. "Reading Ability"...	27 *41*	24 *20*	15 *40*	26 *37*	20 *11*	37 *41*	01 *20*	00 *19*	13 *20*		47 *74*	43 *54*
11. "Arithmetical Ability"	34 *–02*	30 *32*	30 *39*	29 *–11*	26 *20*	41 *10*	32 *30*	30 *14*	16 *41*	47 *74*		51 *46*
12. Imputed "Practical Intelligence"	43 *04*	18 *19*	33 *28*	42 *28*	35 *47*	52 *24*	43 *32*	39 *52*	45 *18*	43 *54*	51 *46*	

degree these differences may be due to sex differences, but they are undoubtedly due mostly to other factors. Consider, for example, the correlations between Crossing Out Rings and Memory for Names: for the girls it is $.17 \pm .07$, and for the boys it is $-.22 \pm .10$. The average of the two correlations is .025. This is about 2 *P.E.* from the observed value in each case. A larger difference is found between the correlations between Memory for Commissions and Crossing Out Rings. For the girls it is $.30 \pm .07$ and for the boys it is $-.15 \pm .10$. The average of the two correlations is .075. This is more than 3 *P.E.* from the value observed for the girls and more than 2 *P.E.* from the value observed for the boys. It needs, however, to be clearly understood that simply as a result of chance errors such differences are inevitable. A study of the differences shown in the table should be of great value to those not acquainted with statistical variations. It should help to prevent the attachment of undue importance to particular values that happen to be obtained from a given set of measurements. Where desired, the probable errors of the correlations may be calculated or estimated by using the appropriate formula (see above, p. 100), or they may be obtained by consulting Abelson's paper. Other phases of this study will be considered later.

Data from Yerkes and Thorndike.—Thorndike has published, from data compiled by Yerkes, the correlations between the different tests in Army Alpha and Army Beta. These tests have already been sufficiently described for present purposes (see above, pp. 84-7) and the description will not be repeated here. Each of these tests was constructed as a test of "intelligence" and it was the intention of the psychologists who constructed them to construct tests which measured different aspects of intelligence. This should be kept in mind. The correlations between the tests are shown in Table VII. They range in size, it will be seen,

TABLE VII

Correlations between Alpha and Beta Tests

(Adapted from E. L. Thorndike.* Original correlations supplied by Yerkes. Decimals are omitted. About 800 cases.

	Alpha								Beta						
	1	2	3	4	5	6	7	8	1	2	3	4	5	6	7
Alpha:															
1. Directions		65	47	55	57	54	71	57	42	52	51	57	48	54	33
2. Arithmetic Problems	65		65	65	66	65	57	66	39	52	61	60	56	52	31
3. Common Sense Questions	47	65		67	62	49	50	60	28	35	42	57	48	44	19
4. Synonym-Antonym	55	65	67		69	50	44	75	30	35	41	48	40	41	16
5. Disarranged Sentences	57	66	62	69		51	54	72	32	40	44	50	46	45	26
6. Number Completion	54	65	49	50	51		51	55	31	46	47	46	47	40	21
7. Analogies	71	57	50	44	54	51		55	29	27	40	46	39	34	23
8. Information	57	66	60	75	72	55	55		30	38	49	57	50	52	25
Beta:															
1. Maze	42	39	28	30	32	31	29	30		43	45	43	34	50	29
2. Cube	52	52	35	35	40	46	27	38	43		57	49	44	51	38
3. Rhythm	51	61	42	41	44	47	40	49	45	57		63	65	13	35
4. Symbol—Digit Substitution	57	60	57	48	50	46	46	57	43	49	63		67	59	34
5. Number Comparison	48	56	48	40	46	47	39	50	34	44	65	67		49	33
6. Picture Completion	54	52	44	41	45	40	34	52	50	51	13	59	49		34
7. Geometrical Construction	33	31	19	16	26	21	33	25	29	38	35	34	33	34	

* "On the Organization of the Intellect," *Psychological Review*, Vol. 28, p. 144.

between .13 and .75, with a median value of about .48. Due to the large number of cases (about 800) the probable

errors of these values are in all cases necessarily quite low. We are thus correspondingly more certain as to the degree of relationship existing between the traits measured by the different tests.

The average correlation of the Geometrical Construction Test with the Alpha tests is .255 and with all other tests, including both Alpha and Beta, is .291. This shows that there is relatively little in common between this test and the others. In no case is the correlation between the Geometrical Construction Test and any of the other tests high. In contrast, the Information Test shows an average correlation of .629 with the other Alpha tests and an average correlation of .494 with the other tests including Beta. The correlation of the Information Test and the Synonym-Antonym Test is so high, .75, that it is evident these tests measure for the most part the same functions. The explanation of these similarities and differences will be attempted presently.

Correlations between Character Traits

While little evidence is at present available as to the degree of relationship existing between emotional and character traits, the indications from the existing material are that the same kind and degrees of relations will eventually be found here as have been found in case of the sensory, motor, and intellectual traits.

THE CAUSES OF CORRELATION

The existence of correlation presents a twofold problem: Why is correlation found at all, and why is it found to particular degrees between different functions? The first question is the major problem, but the answer to it must be such as to permit the answer to the second question as well. Also, the answer in each case must be such as to per-

mit an explanation of the cases which run counter to the general tendency to correlation and show the opposite relation; for, while the measures of a thousand individuals in two traits may show a correlation of .60, it must be kept in mind that this is an *average* and that in particular individuals in the group of a thousand a wide variety of relationships will ordinarily be found. Some individuals may show a negative relation between the strength of the two traits, while others show a perfect or nearly perfect positive correlation between them. And these differences are sufficiently common to make it essential to explain them satisfactorily if we are to have an acceptable theory of the causes of correlation.

Analysis of the Problem

The search for the cause of correlation is essentially the search for the common factors or connecting links between the two series of facts which cause paired measures on the average to show similar—or different—deviations from the averages of the group being studied. By way of clarifying our problem we may first analyze it in certain respects. The first of these relates to the simplicity or complexity of the traits being correlated. If we assume the possibility of securing measures of different specific traits of a simple and elementary character, our problem of explaining any correlations found between them will differ in certain respects from the problem of explaining correlations between complex traits. In reality practically all mental measurements involve a number of factors and the most that we can do here is to recognize differences in complexity and endeavor as far as possible to analyze different complex traits into their simpler components and then determine the effect of each component. We must be particularly careful to avoid the assumption that because we have given tests bearing different names we have tested different and

independent simple mental processes. This particular brand of mediæval philosophic realism is certain to lead to serious difficulties. A second aspect of the problem of explaining correlations concerns the existence of differences in average level of capacity on the part of the subjects measured. If on the one hand we had a group of subjects with the same average mental capacity and on the other hand we had a group varying in average capacity, we should not expect the same results nor should we give the same interpretation in case we did secure similar correlations. In practice nearly all correlations are based on groups of individuals with varying average levels of mentality. The effect of this factor, however, has not been adequately realized. The problem here is often primarily the explanation of the difference in "levels" of average mental capacity. To summarize, in studying the causes of correlations we should pay particular attention to the complexity and consequent overlapping of traits and to the causes and effects of differences in the average levels of capacity of the individuals tested.

Neural Activity and Correlation

Before considering the possible specific causes of correlation it seems desirable to call attention to the relation of the problem to neural activity. In fact, in some ways it will clarify matters if we endeavor to think in terms of correlations between neural activities rather than in terms of correlations between mental traits. To do this, we must of course attempt to outline the probable neural activities involved in taking different tests. The basis for this has already been supplied in some measure in Chapters II and VII. We shall consider here only two examples: Tapping, and the Vocabulary Test.

Tapping is obviously a relatively simple activity. There is no good reason for believing it to involve much complex

associative cortical functioning. It would, then, involve the somesthetic and motor areas of the cortex but would not be affected appreciably by the other sensory and associational centers.

It is stated that the Vocabulary Test in the Stanford Revision of the Binet-Simon Test correlates most highly with the total test score. Let us then consider the probable nature of the cortical functions associated with the Vocabulary Test. Glancing down the vocabulary, I read such words as *orange, bonfire, roar, guitar, health, lecture, artless, shrewd, avarice, retroactive, irony, perfunctory, casuistry,* and *sapient*. Let us consider a few of these words. What must happen in the cortex before the word *orange* is understood? The concept *orange* includes qualities derived from taste, smell, touch, temperature, vision, and even hearing and the kinæsthetic senses. All of these have been associated. Also they have been associated with events, times, places, and people. In cortical terms, then, most of the primary sensory centers have been involved in our reactions to oranges. The cortical association tracts (see Fig. 7, p. 28) have also been involved in linking up these sensory impressions. Images, memories, and associations still further extend the ramifications of the neurone connections involved in the reaction of the organism to orange with the result that it involves a rather large sample of cortical possibilities. Space does not permit an analysis of each of these words, so we shall consider only one more, the last of those referred to, *sapient*. To learn the meaning of *sapient* one must have had a variety of experiences and must have reached the stage of comparing and evaluating them. This requires a large number of what we may call primary impressions and then the association and comparison of these. In cortical terms this will again be found to involve many areas with an exceedingly complex network of neurone connections. In this case the association centers

may be assumed to be much more important than in case of the experiences associated with *orange*. Definitions of *sapient* will thus be both fewer and inferior to those of *orange*.

When a list of words is given for definition, it is evident that such an extensive sample of cortical neurones is involved in giving the answers that we should naturally expect a rather close relation between the results of a vocabulary test and the result of a group of more specific tests. At the same time it is entirely possible that a vocabulary test will fail to be affected greatly either by a serious deficiency or by a marked superiority if these happen to be of rather specialized character.

We shall consider later the application of this principle to the interpretation of test correlations. It is sufficient here to note that correlations may be due to the fact that different tests have involved, in part, the action of the same neurones or, if not of exactly the same neurones, at least of neurones in the same areas where some similarity in functional efficiency might be expected.

With these necessary preliminary matters disposed of, we may now attack the problem as to the specific causes of correlations.

Causes of Correlation within the Same Level

Chance.—When only a limited number of cases is studied, it is quite possible to find correlation simply as a result of chance agreement of results. If this is the cause of correlation, a consideration of a larger number of cases will eliminate the correlation or reduce it to negligible size. In practice, however, this is often a factor of vital importance in determining the size of correlations.

Selection.—If we test the pupils in a given school grade and determine the correlation between age and intelligence, we ordinarily find it to be significantly negative. This

does not mean that *in general* there is a negative relation between these two variables but only that through the working of selective forces such a condition has been produced at a given grade level. It would also be possible in a similar way to secure either positive or negative correlations between traits at a given intelligence level if we consciously or unconsciously used appropriate selective measures.

Causal Relations.—Some correlations are due to the fact that the two variables stand in the relation of cause and effect, as, for example, mechanical memory and proficiency in spelling. Another example might be disposition and social popularity. However, when we find a correlation between two traits, as A and B, it does not necessarily show any causal relation between them in the sense that one is the cause of the other; both may rather be the result of a common cause. This is true, for example, in the case of the relation found between the grades of students in English and in Latin. As a rule the students who take Latin are more intelligent than those who do not take it, so a comparison of the grades of Latin students and non-Latin students in English is a comparison of a more and a less intelligent group. Here the correlation is due to the fact that Latin has selected a more intelligent group, and the difference in intelligence is the real cause of the correlation.

As Otis suggests, we might find a correlation between the grades made by children in school and the number of cooking utensils in their homes. This would not mean that cooking utensils had anything to do with grades, but rather that both could be related to intelligence. The more intelligent parents would ordinarily be in a better economic position and might be expected to have a somewhat more complete kitchen equipment.

Clearly in such cases it makes a great deal of difference

whether we find the underlying connection or not. If we did not find it, we might assume that by increasing the number of kitchen utensils in a home we would thereby improve the school work of the children. It is just such an error that has been made in the case of Latin and English. It has been assumed that if a child only took enough Latin it would work wonders on his work in English.

Identical Elements in Complex Traits

If we measure a trait which involves several different elements, as *ABCDE,* and we measure another trait which consists of elements in part the same, as *ABCFG,* we would naturally get a correlation because the group of abilities, *ABC,* is measured in each case, and entirely apart from any possible relation of *DE* and *FG* we should find a correlation between the two series of measures. The number of possible common factors is practically unlimited, so we shall consider only a few examples.

Language.—Every test of the conventional sort requires that certain directions be conveyed to the persons tested. This is ordinarily done by means of oral and written language, though it may be done by means of gestures, pictures, etc. Also, the content of most of the common tests is very largely linguistic and the responses are in terms of language. Even in case of many performance tests an introspective analysis would show that language entered into the performance and conditioned the result. Here then is an element which is very likely to cause some degree of correlation between different sets of measures.

Speed.—If a series of tests is given with time limits and more material is given than any member of the group can cover, it may quite naturally follow that the results will correlate simply as a result of the fact that all are measures of speed. In certain instances the correlation need not involve anything more than speed in the use of language.

Some are rapid readers and some are slow readers, and the rate of reading is known to be greatly influenced by training. The bearing of this on correlations between our common group tests is obvious.

In speaking of the effects of *speed* we must not assume that an individual is equally speedy in all things. Some rapid talkers are very slow in doing things with their hands. Some who show great speed on the cinder path show a lamentable lack of it in things academic. There is no common speed factor in all kinds of mental activity, though there may be a common factor in a given battery of tests.

Interest and Effort.—On the more emotional side correlations may be due in part to such a common factor as mental attitude and interest with a resultant effect on the effort put forth. Such factors as the attitude towards tests or towards the examiner may have an important effect. Other things being equal, we may expect the interested student to do somewhat better—perhaps much better—than the one who is lacking in such interest. The examiner is supposed to endeavor to motivate all students to do their best, but we have no right to assume that all put forth the same amount of effort. Here again, however, we have no right to assume that such differences in interest or effort will be uniform in all kinds of mental activities: a student may put forth great effort in one direction and very little in another.

Effect of Different Levels of Ability

Suppose we have a group of individuals all of the same average level of ability but with the different abilities uncorrelated. Suppose we combine this group with another group of the same kind with the exception that the average level of ability in the second group be different—either higher or lower. If we now determine the correla-

tion between two traits in the composite group, we shall find that we have a positive correlation. In fact, it is possible by combining groups to turn a negative correlation into a positive one. A common example of this is to be found in the correlation between age and intelligence in school children. If we take a single grade, the correlation is negative; if we take a number of grades, the correlation becomes positive. It is then important to consider the factors which may cause differences in average level of ability.

Effect of Age Differences

Reference has already been made to the effect of taking a number of ages when studying test correlations. There is no doubt that, in general, abilities increase with age from birth to maturity. We may, therefore, by giving tests to several grades find a correlation which depends almost entirely on the age differences. A large part of the published correlations are vitiated by this fact.

Chance

If one tosses 100 coins there is theoretically an equal chance for each coin to fall heads or tails, so that the most probable guess as to the distribution of heads and tails out of the total of 100 coins is 50 heads and 50 tails. At the same time it is very improbable that exactly this result will occur in any single toss. If we made a very large number of tosses of 100 coins, we should at times get less than 40 heads and at other times more than 60 heads. In the same way, and purely as a result of chance, we must expect a difference in the average level of abilities in human beings. Averages and probabilities often mislead us into believing that the improbable does not occur. Yet the occurrence of the improbable event is in some senses certain. The occurrence of certain combinations of spots on dice is less

probable than the occurrence of other combinations; yet these improbable combinations do occur, and they occur with as much mathematical regularity as do the others. Probability and chance, then, are not to be overlooked when we are considering the causes of differences in average level of ability.

Effects of Selection

College students are in general superior to the average in many respects. The reason for this is that they have survived a lengthy process of elimination which has weeded out most of those who entered the first grade. They have been selected for fitness in the things making for success in school work. Of course, they may have attained college rank by expertness in deceiving their teachers as well as by expertness in the mastery of the curriculum; but in any case they have survived the perils which others have been unable to master. They are a selected group and to that extent they differ from a random sample of the population. As a result of this selection there is probably more uniformity in the level of linguistic and mathematical abilities in college students than in the general population, for the reason that a marked defect in either line might prevent admission to college.

From the above it should be clear that selection may operate to produce a group with either a high or a low level of ability. Biological selection has probably had its effect in determining average differences in the levels of ability in different races. The really important problem, however, is the explanation of the differences in average level of the abilities of different persons.

That selection might be the cause of some correlations is generally recognized. There is, however, a special form of selection which undoubtedly operates in such a manner but which is quite commonly overlooked. The factor here re-

ferred to is marriage selection in the form of assortative mating or the mating of like with like. To begin with, let us assume an original condition in which abilities in individuals showed no general correlation and in which the selection of mates was largely a matter of chance. This would mean a population with less variable "general ability." At the same time there would be, simply as a result of chance, some individuals with a higher average of ability and some with a lower average of ability. When marriage selection begins to operate in a conscious way, there would be a definite tendency for like to marry like. The man of low mentality would have slight chance of marrying the woman of superior ability. In the course of time such a process of selection might well be expected to result in a correlation of those abilities and traits which affect marriage selection. Those traits not greatly affecting marriage selection would, on the other hand, show little or no correlation. And such traits as were considered objectionable would show a negative correlation with the ones considered desirable.

Theoretically, such a process as the one described above would seem to offer a plausible explanation of correlation as a general tendency and at the same time offer a very satisfactory explanation for the many cases that run counter to the general tendency. Before the importance of this factor can properly be estimated, however, it will be necessary to do considerable testing of parents and children of different social levels. This must be done with a considerable variety of tests.

Effect of Differences in Blood

Much has been made of the possible effect of differences in the blood as a cause of correlations. The possibilities here are much increased by the discoveries of the effects of internal secretions. There is no doubt, for example, that a

deficiency in the function of the thyroid may cause mental deficiency which is general. All mental capacities are lowered and they are lowered with a reasonable degree of uniformity. In such cases the feeding of thyroid extract will cause a recovery to what is normal for that particular individual, *but* feeding an excess of thyroid will *not* make a genius. This is a very important consideration. While a deficiency in nutritional conditions may bring a decided impairment in ability of a general sort, there is no evidence to show that anything ever raises materially the average of abilities above what is normal for a particular individual, and this norm appears to be set by hereditary factors. Neither does the evidence justify the belief that the low grades of ability are due to any great extent to nutritional or environmental factors. The variations in the abilities of twins are such as to make such a factor very questionable. The major difficulty, however, in the way of the hormone or blood theory of correlations lies in the cases of extreme deviations in different directions. To explain the extraordinary ability of the idiot-savant in one direction would require the assumption of excellent hormone and blood quality and supply, and in such a case some other explanation must be found for the low level of other abilities. Very puzzling indeed would be those cases of apparently normal or average individuals who show extraordinary ability along a particular line, *e.g.,* chess. One may recall here the boy of 8 who defeated a large number of old and experienced champions at chess but in other respects was not considered exceptional. Even though we recognize the importance of hormones and other constituents of the blood, it at present seems quite impossible to work out any detailed theory as to how such differences in ability could be due to the blood when we consider the actual distribution of cerebral blood vessels and the nature of cerebral circulation. If the differences between traits were not so variable, the blood the-

ory might conceivably have possibilities; but unfortunately it proves too much.

Our knowledge of the physiology of the neurone is confessedly deficient. This is especially true of certain aspects of differentiation and growth. And before we can estimate with much accuracy just what and how much effect the blood may have on correlations, we must have a better understanding of how it influences the differentiation, growth, and functioning of nerve cells. It is important, however, to recognize that each cell is anatomically and physiologically something of an independent unit. It receives food from the blood, but this food is digested by the cell nucleus and transformed into a form suitable for use by the nerve cell. The Nissl bodies appear to be an energy reserve which has been thus stored up. But the amount of the Nissl substance in different nerve cells varies greatly. This is true in spite of the fact that all cells are supplied by the same blood stream. We may, therefore, compare the effect of the blood on mental abilities to the effect of the food in a large college dining hall on the muscular strength and other abilities of the individual students. All students eat from the same food supply, but they may select somewhat different foods and may eat different quantities. Even if all ate the same amount of food, or the same amount in proportion to body weight, they would not assimilate the food in the same way and with the same results. Some would be very strong and some relatively weak. Some would remain thin and others would accumulate a reserve of fat. The result depends not only on the food, but on the assimilative machinery which handles it. So in the case of the blood and the nerve cells: the final result depends not only on the quality of the blood, but on the assimilative machinery of the different neurones, and for practical purposes the latter factor is under ordinary circumstances to be considered the really important factor.

Excessive fatigue, toxic drugs, high fever, or other unusual conditions might make the condition of the blood the more important, but we are not here interested in correlations due to such causes. It seems necessary, then, here to reject the idea that correlations are due ordinarily to the action of hormones or to other qualities of the blood.

Spearman's Two-Factor Hypothesis

Among the speculations attempting to account for the correlations usually found between mental capacities is that of Spearman who holds that correlations are due to the presence of a common factor which was formerly called *general intelligence* but which more recently (1925) Spearman prefers to call simply *G*. Spearman supposes this general factor to be a central energy which works through the different neurones. He further supposes that the energy may be shifted from one neurone group to another much as one shifts the flow of an electric current by throwing a switch, or, more appropriately perhaps, the energy moves as an independent center of force. In any case it works through the neurones, which are referred to as *engines*. The amount of the general energy is supposed to be constant, and from this very questionable assumption Spearman deduces certain supposed *laws* of mental activity. The engines themselves are supposed to be of different degrees of efficiency and so the general energy achieves results of different degrees of efficiency. This is the basis of explaining individual differences in different abilities. But as all involve the action of the common factor, *G*, they are all in some measure alike. This is the supposed basis of correlations.

Spearman's hypotheses have been subjected to severe criticism, but it would take us too far afield to go into detail here in considering the criticisms advanced. Four chief objections to his suppositions will, however, be stated. First,

the statistical proof by which Spearman attempted to prove his hypothesis has been very destructively criticized by Thomson. This criticism may be read with profit by the advanced student. Second, Thorndike and his students have applied to a considerable number of correlations the statistical formulæ developed by Spearman but have failed to secure results in agreement with Spearman's claims. Some of the results are in fact decidedly contradictory to the assumptions connected with the two-factor hypothesis. Third, the idea of a common cortical energy which can be shifted around from center to center is contrary to our knowledge of the circulation of the blood, this being one of the agencies invoked by Spearman to account for the common factor—and is also contrary to the generally accepted theory of the action of cortical neurones. Nerve energy is supposed to be a property of individual neurones and there is no known basis by which it could be shifted from one neurone to another. Fourth, it is possible to explain the facts of correlation on the basis of known facts, and it is consequently a serious breach of the principle of parsimony to make such an unnecessary voyage into the unknown as Spearman has made. We shall, therefore, reject Spearman's theory of *G* as unproved and as unnecessary.

Even if later research should show that there is a small grain of truth in the hypothesis advanced, it seems clear on the basis of cases such as the idiots-savants that the general factor is of small importance and that other factors must be brought in to explain the greater part of most correlations. If Spearman abandons the term *general intelligence*, his view is to that extent less objectionable, but not greatly so if he continues to make use of the conception of a movable central energy operating through engines. Science does not advance by attempting to explain the known in terms of the unknown. Real explanations must be based on facts.

Interpretation of Experimental Results

Now that we have considered in a general way the causes of correlation, we shall return to our experimental results and attempt, in part at least, to explain them.

Most of the correlations obtained by Pyle are so near zero that in view of the unknown size of the probable errors they require little explanation. Such factors as interest and attitude towards the tests and understanding of language are quite sufficient to explain the median correlation of .11. The highest correlation in the list, .49, is found between the Association and the Ink Blots tests. As the latter test is also an association test it should be evident that we are here measuring in part the same functions. The next highest correlation, .37, between Logical Memory and Substitution, can also be accounted for on the basis that both involve the establishment of associations. The lowest correlation, —.27, between Logical Memory and Cancellation, suggests an inverse relationship between these two abilities. This, if significant, suggests an incompatibility between the neural conditions necessary for the greatest speed in cancellation and those necessary for the most accurate logical memory. It is not unlikely that this is in fact true, but more evidence is necessary to settle the point. Some of these tests are not very reliable, it is true, and hence the observed correlations are too low for the age groups studied. The outstanding fact from Pyle's results is, however, that most of the correlations are very low and thus indicate that the functions tested were largely independent.

Abelson's results show higher correlation than Pyle's. Since it is not feasible to examine every correlation, the correlations for girls and boys on each test have been averaged and a list has been made of the 8 lowest and 8 highest average correlations and it is given for purposes of comparison. First the names of the tests are given and then their average correlation:

Memory for Names	Crossing Out Rings	.03
Memory for Commissions	Crossing Out Rings	.08
"Reading Ability"	Interpretation of Pictures	.09
"Arithmetical Ability"	Tapping	.09
"Reading Ability"	Geometric Figures	.10
Memory for Names	Tapping	.11
Memory for Names	Crossing Out Dots	.12
Memory for Sentences	Crossing Out Rings	.12
Tapping	Crossing Out Rings	.44
Memory for Commissions	Memory for Sentences	.44
Interpretation of Pictures	"Practical Intelligence"	.45
"Reading Ability"	"Practical Intelligence"	.48
"Arithmetical Ability"	"Practical Intelligence"	.49
Memory for Sentences	Memory for Names	.54
Crossing Out Dots	Crossing Out Rings	.56
"Reading Ability"	"Arithmetical Ability"	.60

The low correlations at the top of the list clearly require little explanation. Any common factor in them is evidently of slight importance.[1]

The higher correlations require explanation, but the problem is not difficult. Tapping, Crossing Out Dots, and Crossing Out Rings correlate because all involve the common factor of speed of reaction. These are also related to age. The memory tests correlate because they are in part measures of the same thing. The correlations between the estimates of "Practical Intelligence," "Reading Ability," and "Arithmetical Ability" all involve age differences and also involve the personal equation of the individuals making the estimates. In addition there is naturally some overlapping between these abilities. The correlation between "Practical Intelligence" and the Interpretation of Pictures involves age differences but is due probably to an even greater degree to the fact that common abilities are involved. Both involve

[1] The suggestion may even be made here that if the group were more homogeneous the low positive correlations would be replaced by negative correlations.

to a very considerable degree the functioning of the association areas in the cerebrum. Both require the interpretation of common events. When we consider the tests as a whole and the many possible sources of correlation, it is perhaps somewhat surprising that the median correlation is so low.

A list of the 8 lowest and the 8 highest correlations between the different Alpha and Beta tests has been made and is given for comparison.

Picture Completion	Rhythm	.13
Geometrical Construction	Synonym-Antonym	.16
Geometrical Construction	Common Sense Questions	.19
Geometrical Construction	Number Completion	.21
Geometrical Construction	Information	.25
Geometrical Construction	Disarranged Sentences	.26
Cube	Analogies	.27
Maze	Common Sense Questions	.28
Information	Arithmetical Reason	.66
Disarranged Sentences	Arithmetical Reason	.66
Number Comparison	Symbol-Digit	.67
Synonym-Antonym	Common Sense Questions	.67
Synonym-Antonym	Disarranged Sentences	.69
Analogies	Directions	.71
Disarranged Sentences	Information	.72
Synonym-Antonym	Information	.75

The outstanding fact about the low correlations is that on one side we have tests all of which involve the interpretation and manipulation of visual space. This visual-motor combination is not found to be highly correlated with any of the other tests. At the same time these tests do show to some degree the existence of some factor or factors to cause correlation. Attitude towards the tests is very probably one factor. Otherwise the difference in "levels" of intelligence resulting from assortative mating is a possible source of these correlations. School training in some measure may

have entered here. There is certainly no need to assume the existence of any "general intelligence" to explain these low correlations.

Turning to the higher correlations, the Number Comparison and the Symbol-Digit tests involve very similar associative processes and so correlate because in part they are measuring the same capacity. To explain the other correlations a number of things may be necessary. It can scarcely be questioned that the use of language is a factor of vital importance here. This is influenced by the amount and kind of reading done and also by the extent of school training. Speed in reading and comprehending language is especially to be considered. With time limits this is a factor of prime importance. To this may be added the effects of "levels" of ability resulting from assortative mating—and from chance. These tests are of such a character that they might well be expected to reflect any differences in average levels of ability. Here again it is unnecessary to assume the existence of a "general intelligence."

Intelligence as Relational

In denying the existence of "general intelligence" the writer has no intention of denying that intelligent activity involves rather *general* cortical activity. To act intelligently is to act with perspective, to act on the basis of a broad view of things, to act not merely with reference to a single stimulus but with reference to the stimulus and the organism in their total relationships. This requires an individual to draw on his past experience and to relate it to the existing situation. This involves in large measure the functioning of the association areas of the cerebrum. And these areas are the ones which have evolved latest in the process of human development and which show the greatest differences when we compare man with the lower animals or when we compare one man with another, especially when

we compare genius and mental deficiency. The association areas are also the last areas to develop in the individual and their development is associated with the final maturation of the intelligence of the individual.

It is largely to this relational character of intelligence that we must attribute the differences in the average correlations found by Pyle, by Abelson, and by Thorndike. Pyle's tests were mostly rather specific in character and did not involve broad interpretations of relationships; hence the correlations were low. The tests given by Abelson were given to low-grade normal children or to border-line defectives where the capacity to relate things would be relatively low. Naturally this does not make for high correlations. The Army results show higher correlations both because of being based on a more variable group and also because the tests involve to a much greater degree these relational activities. Since each test stimulates very complex cortical activity, there is naturally a greater probability that the tests will correlate. The principle is not unlike that of taking a sample to determine an average. On this basis then, tests involving few relationships may be expected to have low correlations except when the tests measure to a considerable extent the same specific qualities, but when tests are so constructed as to involve complex relational or "intelligent" activities a higher correlation may be expected. This, however, does not involve the assumption of any single general factor in intelligent activity.

Emotional and Volitional Traits

In the absence of adequate measurements we are not in position to state the extent to which emotional and volitional traits are related. From the evidence at hand, however, there is no reason to believe that the situation is essentially different in those fields from what has been found in the intellectual field. Traits appear to be specific rather

than general but with complex traits overlapping to varying degrees, and there is also reason for believing that there are average differences in the "level" of emotional and volitional activity in different people. To some degree, then, it may be justifiable to speak of people as being *emotional* or *unemotional* or as being *weak* or *strong* willed, although fundamentally these are based on a large number of rather specific elements.

Inadequacy of Mental Ages and I.Q.'s

From our discussion of the correlations existing between different traits it is evident that the bare statement of a person's mental age or I.Q. does not give a complete or accurate picture of specific mental characteristics. Two individuals with the same mental age and the same I.Q. may differ greatly in particular capacities and tendencies. It is then highly desirable to supplement these general measures with measures of different traits. For vocational and educational guidance especially it is essential to know a person's strongest and weakest points as well as to know his average ability. These differences may be shown most clearly in a graphic way by making a profile chart or psychogram based on the percentile ranks or standard scores for each trait.

Functional Mental Unity

In drawing the conclusion that the mind may be regarded as a large number of more or less independent capacities and tendencies, there is no intention of overlooking the fact that there is considerable functional unity in the working of the mind and that all of these various traits are parts of the self. Due to this fact the entire array of abilities is usually organized and managed to some degree at least to accord with the chief objectives of the individual. A weakness is protected and concealed, or is exercised and strength-

ened, or is compensated for, according to the circumstances. The effect of nurture upon nature may then be either to increase or decrease the original differences between abilities. Often the tendency is to develop through exercise the natively stronger abilities; in this case the weaker ones are very likely to suffer disuse. Elective courses favor this tendency. When, however, these weaker traits are affected by social requirements, there may well be a tendency to strengthen them, and likewise a capacity above social requirements may through neglect fail to maintain its full degree of superiority. What actually happens will be greatly influenced by the objectives and circumstances of the individual.

General Conclusions

Most observed correlations between mental traits are positive except where the traits are logically opposed. Correlations between traits involving relatively simple cortical activities are in general rather low. Correlations between traits requiring complex relational or "intelligent" activities are higher. The evidence does not require the assumption of any single factor common to all mental activity, except in pathological cases. The differences in average levels of mental capacity can be explained on the basis of age, chance, and selection, especially assortative mating.

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CHAPTER XVIII

APPLICATIONS TO EDUCATION

Intelligence and Educability

Immediate capacity for education depends on mental age, and more remote possibilities of education depend on intelligence quotient. If for purposes of illustration we credit a dog with a mental age of 1 year, meaning that he has the same mental capacity as the average 1-year-old child, we would assume that he should be able to learn to the same degree as the child. No one would think of attempting to teach either the dog or the child the rules of grammar or the principles of chemistry. The dog will never develop to the point where such instruction could be given with success, while the child may do so. The study of individual differences, as we have seen, has demonstrated enormous differences between individuals in native capacity. Some human adults—idiots—have less intelligence than the average dog; other human adults show such a high degree of intelligence that we call it genius. The human race as a whole is distributed between these two extremes with most of the group near a central tendency which in terms of the Binet scale is probably about 14 years. In any case the difference between the most intelligent man and the least intelligent man is about twice as great as the difference between the average man and the average dog. And the differences in capacity for education show the same degree of variation. Modern study of intelligence and learning has demonstrated this beyond the possibility of doubt for those familiar with the evidence. It is, then, evident that no

educational system can be efficient and really successful unless its curricula, its methods, and its organization take into account in a proper and adequate way these differences in native capacity.

Until recently, however, our educational system has worked in large measure on the patriotic assumption that "all men are created free and equal." If they were not so, it was deemed the business of education to make them so. This is still a prevailing assumption with a considerable body of unprogressive teachers and executives in educational circles.

For convenience we shall consider in turn some applications to the elementary school, the high school, and the college.

THE ELEMENTARY SCHOOL

The First Grade

Under present conditions children are permitted or required to enter school at certain fixed chronological ages. In general, 6 years is the legal age of entrance, and the average age at entrance is about 6.5 years. If some of the laws were enforced, all children would enter after the age of 6 and before the age of 7, though this rarely happens.

When the children enter school, they are placed in sections without reference to differences in mental capacity. At times this is perhaps necessary, as in small towns, but in large cities where there are many sections of first graders the same practice is usually followed. Under such conditions a first-grade class may contain children of various grades of mentality from 4 to 9 years, or yet more extreme deviations may be found. Under average circumstances, and assuming for convenience 100 children all exactly 6.5 years of age, about 25 of them would have mental ages of less than 6 years and an equal number would have mental ages of 7 years or more. The lowest 10 per cent would have

mental ages of 5.5 years or less, and the best 10 per cent would have mental ages of 7.5 years or more. Due to the fact that the children are not only of different degrees of intelligence as expressed by the I.Q. but are also of different chronological ages, the actual difference in mental ages is ordinarily greater than indicated above.

The evidence indicates that first-grade work requires 6-year intelligence or better to be really successful. It is largely a waste of time to attempt to teach a child with 5-year mentality to read. A very large percentage of the children in the first grade fail to complete the work, if we may judge from the reports of the United States Bureau of Education. According to the report, in 1916 the enrollment in the first grade was 58.9 per cent larger than that in the second grade. While there is some slight difference due to population increase, the chief cause of the difference is that many children enrolled in the first grade do not complete the work and are accordingly required to spend one or even two years additional before being promoted. It also happens that something like 30 per cent of the children are of less than 6-year mental age. The facts of inferior mental age and retardation appear to be causally related.

The first problem of the school superintendent is to make some provision for the inferior groups who are not really old enough mentally to learn successfully first-grade work. There are several ways in which this may be done. The particular plan adopted must depend on conditions to be met in each system.

The simplest, though by no means the easiest, method would be to revise our school laws and require children to have a mental age of 6.5 years, to be determined by actual test, before permitting them to enter school. Chronological age could in that case be disregarded. This would mean that the brighter children would be younger and the duller ones older chronologically when they enter school. The

chief difficulty to be met here would be public opinion, and particularly the opinion of those parents whose children were below normal and were consequently kept out of school until they were 7 or 8 years old. If the difficulty is serious enough, it could be met by having something in the nature of kindergarten work for the inferior children. This would supply the day nursery to which some parents seem to think they are entitled when their children are of the customary school age.

In case of very inferior children it appears that there would be some advantage resulting from keeping them out of regular classes until their mental age is above 6.5 years in schools so small that there can be only one class in each grade. If that is not done, the child will, because of his slow mental growth, gradually drop behind until he fails on a grade. To illustrate this let us suppose a case of border-line mentality with an I.Q. of 75. He would reach a mental age of 6.5 years at the age of 8.67 years. Suppose he entered school at that time. Four years later his mental age would be 9.5 years and his chronological age 12.67 years. He should by that time have completed the fourth grade, but the average mental age of those completing the fourth grade is fully a year higher. He would, therefore, most likely fail then, if he had not already failed in the second or third grade. By failing and repeating the grade he would perhaps pass on the second attempt, as his mental age would be 10.25 years. If he passed on the second attempt, it would be due quite as much if not more to the fact that his mental age was greater as to the fact that he had studied the subject twice. This being the case, the failure the first time could have been prevented if he had entered school later, *i.e.*, at the age of 9.5 or 10 years. This is the cheapest and simplest solution for small school systems; but, as the writer appreciates, it may be open to certain strong practical objections. Each superintendent must judge for himself as to whether

he can safely attempt to secure the acceptance of such a plan for dealing with subnormal children. As far as the schools are concerned it would in all probability lead to better results. It would avoid a large part of the failures and the corresponding expense to the school system. And what is of more importance, it would avoid the discouragement to the pupils caused by failure. It would lighten the burden of the teachers now called on to attempt to teach what cannot be learned and it would improve the morale of classes and increase the speed of learning, because the average classes would not be handicapped by the laggards. Dishonesty in school work would be reduced, because inability to do the work is one of the most potent causes of irregular practices.

Advantages of Late Entrance

The writer believes, though proof in perfectly satisfactory form is not at hand, that in the interests of health and school economy it would be better to postpone the age of school entrance for all children until they have reached a mental age of 8 years. The present elementary school course could then be covered in a more satisfactory way in 6 years. It even seems a safe prediction to suggest that children entering with a mental age of 9 years and spending 10 or 11 months in the year would come out at the end of 5 years as well equipped for high school as are our present pupils. Proof of this on a large scale cannot be submitted, but numerous individual cases are known where children entering at 8, 9, or 10 years have made up the ground lost and have been placed with children of their own age who had been in school since they were 6 years old. It can scarcely be maintained that these children would not have advanced in a more satisfactory way if placed in rapidly moving groups rather than being compelled to make up work in the summer or simply skip grades. Since both

financial economy and considerable benefits to health should result from such a plan, the experiment would be worth making on a large scale.

Classification of Pupils by Mental Tests

As a prerequisite to any scientific adaptation of the school system to individual differences there must be a general testing program before or at school entrance so that the differences in capacity may be known. Fortunately there are fairly satisfactory group tests for this purpose. These must, of course, be supplemented by individual tests in some cases. The cost of this to the school system can be more than saved, if necessary, through efficiency and economy which result from scientific classification. There would be fewer children who would have to be taught two or more years in the same grade.

If tests are given to all children before or at school entrance, the next step, where it is possible, is to divide the children into groups according to mental age. The number of groups will depend on the size of the system and on the location of the schools. The larger the number in a particular grade that can be gotten together in one building, the larger the number of sections that can be made and the more homogeneous each group will be.

Some teachers object to grouping children on the basis of mental age because, they say, the poorer children receive much benefit from the example of the brighter children. No experimental evidence can be offered to support this view. Furthermore, it is in conflict with the very principle on which our present system of classification by grades is based. We would not think, for example, of placing first- and fourth-year Latin students together so that the former might be inspired by the latter. It is also held that placing students in groups is humiliating to those in the inferior groups. Actual trial does not bear this out. Tact must, of

course, be used, and the inferior groups must not be told that they are inferior or referred to as subnormals. It cannot be denied, however, that it is humiliating for some children to be placed in groups where they are hopelessly inferior and cannot avoid seeing it for themselves. Also, where as a result of inferiority they fail on a course and have to repeat it, the result is worse than if they had been placed in a section where they could have done the work successfully.

Adjusting the Curriculum

When classes are sectioned, in order to get the best results, a revision of the curriculum and different rates of progress for the different sections are necessary. The brighter students are capable of doing more work and more difficult work and progressing at a faster rate than the normal and subnormal sections. Two alternatives are possible here: the brighter children may do more work in each grade and take the regular 8 years to finish the elementary school or they may finish the regular course in less time. Probably the former alternative is to be preferred, if the mental age of entrance is 7 years or less. This would permit much supplementary work in history, literature, geography, hygiene, nature study, civics, and art. In the same way the slower students may complete only the minimum essentials of each grade and finish the course in 8 years, or they may do the work of only 5 or 6 grades in 8 years. This general plan, it may be noted, of classifying children and having them progress at different rates was successfully tried at Cambridge, Massachusetts, long before classification by means or mental tests was possible. It is, therefore, not exactly a fad originating in the minds of the mental testers; they have merely made it possible to carry out the plan more effectively.

It should perhaps be emphasized that the low-average

and subnormal groups should have their course of study modified so as to include very much less in the way of formal grammar and advanced arithmetic, these being the most abstract and consequently the most difficult subjects in the grammar-school curriculum. This will also save time that can be used more profitably by requiring intensive work in the fundamentals of the topics covered.

Methods of Instruction

On the side of methods of instruction much can be said in favor of classification on the basis of differences in ability. The brighter students usually think much faster than the slow ones. Consequently, if the two are together and a problem is presented, it will be solved by the brighter members of the class before the slow ones have been able to make a good start on the solution. The bright child who first gets the answer is often permitted to give it and this prevents the slow child from thinking it out for himself. When the slow students are in a class composed entirely of slow thinkers, they have a more nearly equal chance. The writer has taught slow sections in psychology and has secured very much better results from the poorer students under those conditions than when they have been in a class composed of all classes of students. The same will apply to all subjects. It is quite impossible for the teacher to adapt the methods of instruction to all classes in a mixed group. If he adapts the work to the brighter students—and there may be a temptation to do this—he talks over the heads of the majority of the class or he travels entirely too fast for them. If, on the other hand, he adapts the instruction to the slow members of the class, he bores the better students by dwelling long on simple things. When students are properly classified these difficulties disappear. It is easy to use the methods best suited to the class.

Limits of Educability

In connection with planning the curricula and rates of progress of the different groups, the question arises as to the significance of their final levels of development in intelligence. As we have seen in Chapter IX, we do not know exactly how intelligent the average American is. The result of the Army tests gave a Stanford-Binet mental age of 13.08 years, but it may be justifiable to raise this to 14 years. The evidence indicates a rather close relation between school progress and intelligence, and according to this, if education and intelligence were proportional in the population as a whole, we should expect the nation to have an average education equivalent to the seventh grade or a little better. According to the United States Bureau of Education it is less than this, or about sixth grade. In some states it is lower, in others it is higher. In no country has it ever been true that the average education was greatly above the present level in the United States, and there is ground for strong doubt as to whether it is possible as long as present curricula and standards are maintained to raise the average education more than a year or two. Experience has demonstrated that with the spread of education to the classes of less intelligence it has been necessary to restrict or omit the study of certain subjects heretofore required, especially the classics and mathematics. Greek has been practically eliminated from the public schools and new courses have been developed so that students may take a high-school course without taking Latin and by taking little or no mathematics. Numerous educators lament this tendency as a lowering of standards. It is, however, the inevitable result of democratizing our educational system. In England where the secondary-school system is decidedly undemocratic the classics and mathematics still have a very strong hold. The larger the enrollment in grammar school, high school, or college, the lower the average level of men-

tality will be and the easier the curricula must be. This conclusion is unavoidable.

Under favorable conditions 50 or 60 per cent of the population might be expected to finish the grammar school if the work is adapted to their needs. Fully one-third can hardly hope to do really successful work in the seventh and eighth grades as now constituted. This slower group must have a modified curriculum if they are to remain in school and do profitable work. The school cannot change the original natures of the children in the sense of improving their capacity to learn. It must change its own requirements, or the lack of adjustment now found between pupils and schools will continue.

The tremendous importance of this problem will become clearer if we consider some statistics of school enrollment. Table VIII shows the estimated enrollment by grades for the United States for 1916. If we pass over the first grade

TABLE VIII

ESTIMATED ENROLLMENT BY GRADES IN THE PUBLIC SCHOOLS IN THE UNITED STATES IN 1916 *

Grade	*Enrollment in Thousands*
1	4,596
2	2,893
3	2,720
4	2,597
5	2,206
6	1,809
7	1,492
8	1,244
9	585
10	390
11	274
12	208

* Report of the United States Commissioner of Education, Government Printing Office, Washington, D. C., 1916, Vol. 2, p. 7.

and take the second-grade figures as being more nearly normal, we note a drop of nearly 50 per cent by the seventh grade and in the twelfth grade there are only 7.2 per cent as many students as we find in the second grade. Whatever the cause, clearly there has been a terrific elimination from school, though by more rigid enforcement of attendance laws

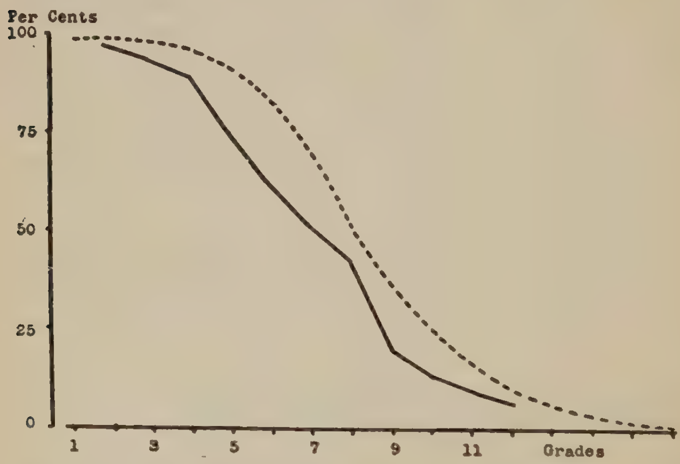


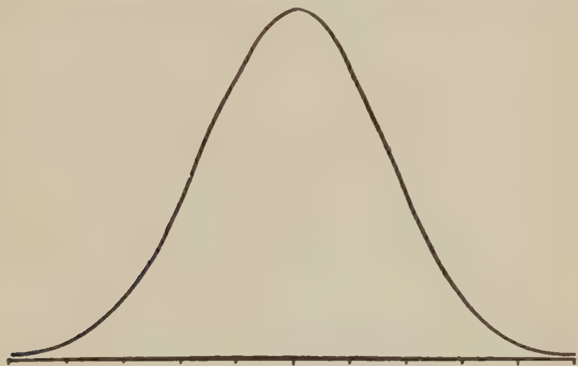
FIG. 45.—SCHOOL ENROLLMENT BY GRADES (SOLID LINE) IN THE UNITED STATES IN 1916 COMPARED WITH ESTIMATED THEORETICAL EXPECTANCY OF EDUCATION (DOTTED LINE).

For discussion, see text.

and by making the curriculum easier the present tendency is to decrease the degree of elimination.

In Figure 45 the estimated grade enrollment as shown in Table VIII has been compared graphically with a curve showing the elimination to be expected if there were a perfect correlation between final mental age and grade reached at time of elimination, with the further assumption that the final level of intelligence in the population is represented by a normal curve with a mean Stanford-Binet

mental age of 14 years and with a standard deviation of 16 I.Q. units. This comparison fails to take account of changes in birth rate and also of reductions in population due to mortality; but even if these corrections were made, there would still be a marked correlation between our theoretical expectations and the actual findings. This same theoretical



I.Q.	50	60	70	80	90	100	110	120	130	140	150
Adult M.A.	7.0	8.4	9.8	11.2	12.6	14.0	15.4	16.8	18.2	19.6	21.0
Ed. Limit in Grades	1.0	2.4	3.8	5.2	6.6	8.0	10.0	12.0	Col.	Univ.	
Percentile	0.0	0.6	3.0	10.6	26.6	50.0	73.4	89.4	97.0	99.4	
Per Cent Remaining	100	99.4	97.0	89.4	73.4	50.0	26.6	10.6	3.0	0.6	

FIG. 46.—ESTIMATED DISTRIBUTION OF INTELLIGENCE IN THE GENERAL ADULT POPULATION IN THE UNITED STATES IN RELATION TO ESTIMATED FINAL LIMITS TO WHICH EDUCATION MAY PROFITABLY BE CARRIED WITH OUR PRESENT CURRICULUM.

expectancy of education has also been shown in Figure 46. The normal curve is drawn, as stated above, with a mean of 14 years in Stanford-Binet mental age and with a *S.D.* of 16 I.Q. units or of 2.24 years of mental age. The figures given are naturally somewhat tentative since we do not know exactly the true figures. Also, the educational limits stated are meant only as rough indices.

THE HIGH SCHOOL

Variations in Ability and Electives

Individual differences in the high-school course are ordinarily less than in the elementary school because of the selective effect of failures throughout the elementary years. There remains, however, a very considerable degree of variation. A further difference is found in the fact that with the high-school period comes a greater degree of specialization. Large cities offer a number of possible courses: classical, scientific, general literary, commercial, manual training, domestic science, etc. Successful work in any of these courses requires a certain degree of intelligence. Some of the children who finish grammar school will hardly be profited by attending high school at all and these should be advised not to continue in school. Those who do continue should take courses for which they are qualified. The evidence shows that a higher mental capacity is necessary for success in classical and scientific courses than in other courses. Only the brighter students should take such courses, and any dull pupils intending to take them should be encouraged to take some other course. It may not be expedient to make any absolute requirements in that direction, but the teachers can at least use their influence to bring about a satisfactory classification. There is also need of encouraging some very capable students who are lacking in educational ambition. Some of these will not go to high school at all unless they have special encouragement.

The high-school course desired by many boys and girls is often determined by opinions held by their parents that certain subjects are necessary for an educated man. Many, perhaps the majority, still believe in some magical "improvement of mind" as a result of attending classes in particular subjects—notably mathematics and the classics.

In Chapter VIII, on the influence of the environment, we have shown that such a view is not in accord with our present knowledge of educational psychology. Nevertheless, the view survives in some circles almost as a sacred dogma, and the school authorities have it to deal with. If a boy of low mental capacity comes to high school with the idea that he cannot be an educated gentleman unless he studies Latin, it may be necessary to admit him to the course, but it is evident that he would profit more from some other subjects.

The Problem of Special Abilities

In addition to the problem of general level of intelligence there is the further question of rather wide differences in specialized abilities and their relation to the course selected in high school. In the elementary school the content of the course of study may be regarded as essential, and although some children may be known to be very poor in arithmetic and others in spelling, etc., because of the great practical importance of a fair knowledge of those subjects it is necessary that they be studied. In high school the same cannot be said. Nothing in the high-school curriculum can be considered a necessity for all people. Particular subjects may indeed be necessary for certain kinds of work. High-school mathematics is a necessary foundation for an engineering course; high-school Latin is very desirable for a prospective teacher of English, etc.; but many well informed men and women have studied neither. Should a student weak in mathematics be required to study it in high school? According to the theory of formal discipline still held by many educators but discarded by psychology they should. It is urged that such a study will improve the powers of concentration and reasoning ability. As there is no satisfactory evidence to support such a view, we are not justified in requiring courses on that ground. Of course if a

student expects to study engineering he should take high-school mathematics, but if he is weak in mathematics he can never be a success in engineering and should enter some other kind of work where he has the capacities necessary for success. The logical deduction is, therefore, that ordinarily the student weak in mathematics should not be required to study it in high school. Most colleges do, indeed, require students to take certain high-school subjects, but such requirements are reflecting more and more an intelligent understanding of individual differences, and it is now possible to enter some standard colleges without any credit in some of the time-honored subjects. There is no special disciplinary argument that is in itself a sufficient excuse for studying any high-school subject, and it is evident that the student who has special difficulties with a subject and is forced to study it can scarcely escape having a great dislike for it. A student with capacity for the study of English and history in high school should not be driven from high school by requiring him to take things for which he is not fitted. This applies naturally in all other directions.

When such specialization is permitted in high school, it will perhaps be necessary to give diplomas indicating the kind of work that has been done just as now the diplomas indicate whether the course completed was classical, scientific, or otherwise.

If the study of individual differences and of the effects of education leads us to favor extreme specialization in particular cases, it by no means does so in general—quite the contrary in fact. Study of the matter shows that no subject too exclusively pursued can give the broad outlook necessary for a really educated man or woman. Chemistry is an excellent study, but it gives no information about the history of ancient civilization and no amount of knowledge of chemistry can take the place of knowledge of history. The

same holds for other subjects. Human capacities are many and varied, they are specific, and, if we are to attain a broad understanding of the world about us, it must be done by the study of many things. Music, painting, literature, history, botany, astronomy, French, Greek—all these and many others make their special contribution. The well educated individual may not find it possible to know every branch of human knowledge, but he should have a wide and varied knowledge. It is the absence of this that gives us so many narrow minds among the so-called educated classes.

Social Education

Contemporary educational thought makes much of social education. It is beginning to be realized that social capacities are themselves specific and that a man is not necessarily a better citizen because he has pursued the conventional subjects in the conventional way. The study of individual differences shows us that some children are more anti-social than others, and it should be part of the business of our educational system to locate these cases and give them the best social and moral training possible. Passing over the extreme cases and dealing primarily with the typical individuals, too little attention is paid to the ideal and social values of the study of literature and of history. The study of English is too often a matter of analytical dissection to show what success the writer had in balancing his sentences or in organizing his paragraphs rather than a matter of getting what the writer was endeavoring to express. Some analysis is, of course, essential, but there is more room for the consideration of the effect a piece of literature may have on moral and social development.

In this connection something might be said as to religious education. Though this is not a problem of the public schools, it is at the same time a matter of considerable interest. Individual differences are not limited to the in-

tellectual field; they apply in the religious field as well. Religious education presents the same difficulties as intellectual education in the way of making adjustments for individual differences. Some children take naturally to religious training; they enjoy religious studies and activities just as some boys take quite naturally to football. In contrast to these are children whose intellectual and emotional dispositions cause them to find little of interest in religious study and activity. They find church activities tiresome or disagreeable. There is, therefore, no reason to believe that a uniform procedure in religious education will be any more successful than a uniform procedure has been in intellectual education. Variation in religious curricula and methods are as essential for success as are variations in other fields of education. The churches have as yet scarcely recognized this fact and have tried to cast all their members in the same mold. Partly as a result of this different creeds with different methods have developed.

Mental Maturity and the Curriculum

The final age of mental arrest or cessation of growth has an important bearing on the high-school curriculum. When does mental capacity stop increasing? Until recently it was assumed by some educational psychologists that mental growth stopped at the age of 15 or 16. That view is no longer entirely acceptable. The available evidence indicates that the age of cessation of mental growth depends on the final level reached. There is some evidence to show that even in high-grade mental defectives it may continue to some degree beyond 16. For average and superior students it continues probably longer, but just how much longer we do not know, nor do we have the instruments necessary to make satisfactory measurements. Probably the high-school student does not ordinarily attain his final level until about the time he leaves high school.

Of all the subjects in the high-school curriculum algebra is undeniably the most abstract and hence requires the highest degree of mental development. Geometry is more concrete and hence easier. Yet the study of algebra almost invariably precedes the study of geometry. There is no good reason for this except that it has been done that way for a long time. It is consequently not surprising that the number of failures in algebra should at times have been so numerous that they have excited some concern. The true situation is probably worse than the apparent one: many students who secure a passing grade do not understand the subject—they pass by memorizing it. As long as no original problems are introduced they do well, but once the originals appear the results are very, very poor. This can be demonstrated on almost any algebra class in high school.

The results of the study of mental growth would require us to postpone the study of algebra to the latest possible time in high school, and preferably for students not specializing in mathematics or related subjects it should be given in college. The present high-school mathematics could be given to much better advantage in the first year in college. The students would be more mature and the poorer high-school students would have been eliminated. When the fact is appreciated that the majority of the population never reaches the point where it can grasp adequately such a subject as algebra, it will be realized that even for brilliant students it would be advantageous for them to delay the study of the subject until after mental maturity, and that certainly is not present at 14 or 15 years. In college it is recognized that the study of philosophy should be delayed until the junior and senior years, but when mathematics is required it is required of freshmen. A consideration of the importance of mental maturity would place mathematics on the same level as philosophy. It should

be delayed as long as practical conditions warrant. The student who is specializing in physics will need an extended training in mathematics and must start sooner, but the average student will not do so. As a substitute for mathematics in high school more work in languages could be given, thereby saving some of the time now spent in college on the study of languages.

It is often supposed that high-school work is an essential prerequisite to all college work. Recent experiments, however, have demonstrated the fallacy of this argument. Men who had not completed the work of the elementary school have been admitted to college on the basis of mental tests and have done better than average college work. Certain subjects naturally require the high-school training as prerequisites, but others, such as the sciences, history, economics, sociology, and philosophy, often have little or no direct connection with high-school courses and the only essential prerequisite is adequate mental capacity—and this is not supplied by high-school training. These experiments supply valuable evidence as to the importance of mental maturity for advanced work.

So important is the level of intelligence that at least one college admits students 23 years of age or older without a high-school diploma in case they pass a satisfactory intelligence test. Other colleges use the test to eliminate those who in spite of high-school graduation are mentally unfit for college work; for it has become increasingly evident that something more than education is necessary as a basis of further education.

Problem of Sex Differences

Another question of considerable popular interest is that as to the relation of sex differences to education. The question often arises as to whether there should be different schools for boys and girls. Some cities maintain separate

schools and in European countries that practice is quite common.

On the whole, the evidence indicates that girls are more precocious than boys in mental growth as well as in physical growth, though the difference is probably not a great one. There is so much overlapping in the two groups that other reasons would have to be found to justify separate schools. The chief argument for separating the sexes into different sections—though this does not necessarily mean different schools—is found in the fact that girls are somewhat better workers than boys, and that there is a tendency in the average mixed class for the boys to do work inferior to the girls. In a test made by the writer where seventh-grade, junior-high-school pupils were classified on the basis of intelligence tests, it was found that boys in separate sections did better work than in mixed sections. In separate sections, for example, they were better in arithmetic than girls of the same grade of intelligence, but in mixed groups they were inferior to the girls. The comparison was made at the end of the year with the Cleveland Survey Tests. The practical difficulty developed, however, that the teachers opposed the classification because the boys were much more difficult to manage when in separate sections. All of the teachers were women and it is evident that with suitable male teachers or with female teachers who were very strong in discipline this difficulty would have been overcome. Aside from that, the separate sections were better. It may take more pressure from a teacher to get boys to work and this can be applied more effectively when the boys are by themselves. In mixed groups the boys show too much of a tendency to let the girls do the work.

In some courses, such as physiology and hygiene, separate sections are desirable for other reasons, and it seems probable that in other courses greater interest might be secured by separating the sexes so that the work could be adapted

to differences in the interests of boys and girls. In any case, the separation must be based on emotional rather than on intellectual differences. From this point of view there is no reason why separate buildings should be used, and except in the largest cities it will usually be more economical to use the same buildings.

Finally, it should be remembered that it is far more important to classify students on the basis of intelligence than it is to classify them on the basis of sex, and both classifications can therefore be made only where numerous sections are possible.

Problem of Race Differences

Race differences may or may not have an important application to the educational system. In the North, where all races go to the same schools, there is usually no need of considering race differences: they take care of themselves. But in the South, where the schools for whites and blacks are different, a consideration of race differences is of considerable importance.

As was pointed out in the chapter on race differences, the Negro is inferior to the white. The mulatto is between the two races. There is considerable overlapping of the two groups, but the difference is large enough to present a distinct educational problem. If we follow the Army tests and credit the Negro with a mentality of about 10.4 years, it is evident that the majority of the Negroes would, under the older classification, have to be considered as mental defectives. Aside, however, from the question as to how they should be classified, it is evident that their possibilities in the way of education are distinctly limited. The average Negro could do little more than finish with success our present fourth or fifth grade. In short, he could acquire only the essentials of the three R's. And the number of full-blooded Negroes capable of finishing with success our present high-

school course would be negligible. With a mixture of white blood the case is of course different, and many mulattoes with intelligent white ancestors have been able to do very creditable work even in college.

As a race the Negro requires a modification of the regular school course. Less of the academic training is possible and more emphasis must be placed on practical work along the line of vocational and industrial training. Less arithmetic and grammar should be attempted. More time should be given to practical trade training. The Negro may be a very efficient workman and the schools could do much to make him more successful and happier, but it cannot be done without a modified curriculum.

The Indians appear to be between the whites and the Negroes in intelligence but on the whole rather lacking in intellectual interests. Their education should thus tend to follow vocational lines except in case of the brighter minority.

No special distinction would appear to be necessary in case of the Chinese and Japanese. They are as intelligent as the whites.

The brown race affects us as an educational problem only in the Hawaiian and the Philippine Islands. The intelligence of the Filipinos appears to be about the same as that of the Negro with the Hawaiians somewhat higher. This presents an especial difficulty in case of the Filipino, because the educational and economic independence of the natives would seem almost impossible unless the island is to revert to barbarism. In the United States the Negro has his affairs managed for him in large measure by his neighbors, the whites; but in the Philippines the natives are more isolated and must to a greater degree manage their own affairs. Hope of great economic progress is consequently not in order. In case of the independence of the Islanders their affairs would naturally remain in the control of the white

settlers there, but they would be able to do less than the Southern whites do for the Negro.

It may be noted in passing that the problem of Mexican educational and economic development is to a considerable extent a race problem. The native Indian elements of the population are more limited in their mental capacity than are the whites and this results in their disliking education—which is practically an insuperable handicap.

TEACHING AND ADMINISTRATION

Problems Concerning Teachers

Principles derived from a study of individual differences have a vital bearing on some problems relating to the teaching staff of our schools. Teachers as well as pupils vary in all kinds of traits and for that reason it should be recognized that teachers have their limitations. Entirely too much has been taken for granted in dealing with teachers' qualifications. Because they were teachers they were supposed to be all-wise and infallible and hence were too often allowed to be a law unto themselves. At last, however, we are beginning to recognize the falsity of such a view.

The intelligence of teachers must vary from border-line feeble-mindedness to genius. The average intelligence of different groups of teachers will naturally vary according to the section of the country and the grade of work taught. Undeniably, however, many teachers are attempting to teach pupils whose intelligence is superior to their own. Clearly, then, we need a selection and classification of teachers as well as a selection and classification of pupils. Only the bright teachers can be expected to understand and to stimulate properly the bright pupils.

While exact figures are lacking on the matter, there is good reason for believing that the relative level of intelligence of the teaching profession is declining. The pay of teachers, never high, has gradually been losing ground until at present

college professors receive in many cases less than manual laborers. The eventual result of this condition is inevitable: an increasing proportion of those intelligent individuals who might have gone into teaching will be diverted into more lucrative occupations. Only the financially independent or the mentally dull and unambitious will consider teaching satisfactory. In elementary schools and high schools the relatively low pay has already driven most of the men out of the teaching profession. One factor in this has been the agitation for equal pay for men and women. Women, from the nature of things, can afford to teach for less than men can afford to teach for. Hence the salary scale has been pushed down to a point that it has little attraction for capable men. The selective effect of such a condition is not appreciated by the general public and until it is understood by them there is little hope for corrective action.

Turning the schools over to women teachers would not be so bad in its effects if it were not for the fact that to so many of them it is only a stepping stone to matrimony. This results in a very high turnover in our teaching force. Far better would it be if the order could be reversed. If the teachers married early and raised their families to school age and then began teaching they would bring to the schoolroom a greater maturity and balance of mind and they could give more undivided attention to their work than can the young girl who is actively in pursuit of a husband. More intelligent teachers and more mature teachers are needed, if we are to secure the best results. There are many other important phases of the problem of selection and assignment of teachers, but we cannot go into them here.

Teachers' Marks

Not so many years ago it was generally assumed that when a teacher assigned a mark of 78, or perhaps 78.42, to

a paper that the paper had been accurately measured. Numerous experiments have shown, however, that marks are subject to striking variations. The mark finally attached to a paper is due to many chance variables as well as to the merit of the paper itself. Two supposedly qualified teachers will vary greatly in the marks given to the same papers. In short, we find the same kind of individual differences in giving examinations and in marking papers that we have found in other fields. We even find the same individual varying greatly from time to time.

With the development of an intelligent understanding of these variations in marks, much effort has been devoted to attempts to correct them. One of the important things has been the development of objective tests. This has done much to reduce the effect of the personal equation of the teacher. Another suggestion often made has been that marks be distributed according to the normal curve of distribution rather than according to the teacher's judgment. While this applies fairly well in some cases, it has usually not been used in such a way as to take into account the differences in different classes. There are individual differences here also and they must be allowed for. A suggestion as to a method of overcoming these differences has been made by the writer elsewhere (1926 and 1927). In brief, the plan is to use the freshman distribution as a basis of grading and in case of small classes high, low, or average distributions of marks are to be given so that the marks received by any class as a whole—*not* individually—will correspond to the marks received by the members of the class in the freshman year. On this basis inferior classes would receive low marks and superior classes would receive high marks, though individuals might shift from low marks to high ones and vice versa.

The divine right of kings is now rightly laughed at by intelligent people. No man is today considered to be infall-

ible. It is, then, in order to question the divine right of teachers to place any mark they please on test and examination papers. By the use of proper methods school marks can be made reasonably valid and reliable and it is nothing more than simple justice that teachers should be expected to use these methods and make their marks much more accurate than they often are at present.

Superintendents and Administrators

We should not leave the field of education without specific reference to the bearings of the study of individual differences on our leaders in educational work. Just as teachers have their limits and are in need of having their divine rights restricted, so is it even more important that the arbitrary exercise of personal authority on the part of executives be markedly reduced. In a matter of such vital importance to the public at large and especially when the public is paying the bill, it is both unscientific and undemocratic to leave the determination of important problems to the judgment and discretion of a single individual if it is practically feasible to submit the problem to a qualified group of individuals. We must abandon our antiquated notions of infallibility in this as in other directions if we are to avoid gross injustice to all concerned. Even if we could assume that all executives are honest and conscientious, we certainly could not assume them to be without personal limitations. In private enterprise where the individual concerned must pay the price of his folly it may be well enough to permit the fullest amount of individual initiative, but in public education the situation is entirely different. We have competent executives and incompetent ones, honest ones and corrupt ones, and it behooves us to act accordingly.

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CHAPTER XIX

APPLICATIONS TO BUSINESS

PERSONNEL MANAGEMENT

Jobs in business and industry vary greatly in the requirements they make on the mental and physical capacities of the men who fill them. The street sweeper requires fairly good physical endurance but little strength or intelligence. To be contented he should also have little social pride or ambition. The hauler of coal may require both strength and endurance, and so with many other manual workers. The mason does not require a great amount of strength if he handles brick, but he may require a great deal if he handles stone. He does require considerable skill if he does work that is to be enduring and artistic. The typist does not require strength but does require a great deal of endurance as far as arm and hand activities are concerned. The typist also requires a higher degree of mental capacity. The telephone operator requires good hearing, good memory for numbers, and a good disposition. The salesman requires social qualities of a high order for the best success. For the best results, therefore, it is necessary to have the proper placing of men so that they are in the jobs for which they are suited.

Adjustment of Men to Jobs

Failure to adjust men and jobs results in considerable economic loss. When a man attempts a job for which he is not fitted, he will ordinarily do less and poorer work than a qualified man would do. He may also waste material.

In handling machinery he may injure himself or others and so cause additional loss. Poor work will usually react on the individual himself with the result that he becomes dissatisfied with his job and this naturally leads to his looking for a new job. If he does not find a new place voluntarily, he is likely to be fired, and in either case the result is the same: an increase in labor turnover.

The statistics of labor turnover, more than almost anything else, have forced employers to a consideration of the problem of adjusting men and jobs. In some kinds of work it is not unusual to have to employ three or four men to do the work of one man for a year. In some cases the figures run much higher. This involves the waste already referred to and in addition it requires extra expense to maintain a larger employment force and more time must be spent in training new employees. In some cases it means that other men are prevented from working, because their work depends on that of the missing man or men. For these reasons an increasing amount of study is being devoted to the problem of scientific employment, though at present it must be admitted that employment psychology is in the experimental stage. Even so, it is possible to outline with considerable confidence a part of the program which must be worked out in order to secure maximum efficiency.

Business men have spent a great deal of money perfecting machinery, selling systems, accounting methods, and other things involved in their business. If a new machine was produced that would do the work more economically, it was installed and the old one was sent to the scrap heap. The time has come, however, when so much specialization has taken place in processes that the next important step in the promotion of efficiency must be in the direction of a study of the men who run the machines, because it is useless to have a machine that is capable of a high rate of produc-

tion unless a man is found who can get out of the machine what it is capable of doing.

Employment psychology is based essentially on four principles: (1) Men show wide variations in specific capacities due to inherited constitution; (2) wide differences in specific skills, knowledge, etc., have been produced by environment, including training; (3) the interests of men are greatly different; and (4), it is possible by means of scientifically constructed tests to determine with considerable accuracy in some cases at least, the fitness of men for particular jobs. These principles are already familiar, but some more detailed discussion of their industrial application may be in order.

Different kinds of work require different degrees of intelligence and men below a certain level will not succeed. Curiously enough there is also such a thing as a man having too much intelligence for a particular kind of work. At first thought this may seem to be impossible, but it is supported by statistical evidence, and further consideration shows that it is the logical thing to expect. Men with a high order of intelligence do not find simple work sufficiently interesting and so they are likely to do it very poorly. Their thoughts are elsewhere. For this reason some employers prefer workers of relatively low mentality for work involving mechanical and routine operations and requiring no special initiative or intelligence.

Since intelligence is not the only factor involved in industrial and business occupations, it is but natural that some variation in intelligence should occur within a given occupation. In point of fact the variation is often a very wide one, because we have not yet arrived at the point where we use efficient methods of getting the right man in the right job. One of the reasons for industrial unrest is the presence of men of superior intelligence in the ranks of unskilled workers. It is not a natural thing for a man to be satisfied

doing a kind of work far below his ability. There is in such cases no stimulus to exertion and no sense of achievement at doing such work well. It should, therefore, be no surprise when such men show their personal discontent by beginning to agitate for things that are economically impossible. If these men were found and transferred to work that would tax their abilities to a greater extent, unrest would often die a natural death. What is needed in most occupations is a narrowing of the distribution of intelligence: the inferior men need to be shifted to easier work and the superior men to more difficult work. Such an adjustment would secure greater efficiency and greater contentment on the part of the workers.

In the actual placing of men in particular occupations we are, of course, concerned with their specific abilities to do that particular kind of work rather than the general average of their abilities and intelligence; but for the most satisfactory placement it is essential that both factors be considered.

The importance of training depends on the degree of difficulty of the particular kind of work. A physician might be a very brilliant man but might be unable to deal successfully with his problems because of inferior training. A man of less ability and better training might prove more successful in a particular emergency. In the long run, however, there is the probability that the more capable man would outstrip the other. Somewhat the same situation holds in industrial occupations. But business men are usually less interested in what a man may become than in what he can do at the moment, and for this reason training is a very important factor.

In addition to the native abilities and the acquired knowledge and skills of the individual there remains the important factor of interest and ambition. Native ability is to be considered as relatively fixed while acquired skills and knowl-

edge do not change very rapidly, but interests may prove in particular instances to be very volatile. The problem of interest, therefore, requires special consideration in the selection of employees. This, for instance, is one of the major differences between men and women in business work. The average man in business expects to stay in business and looks at his work in a more serious way than the average girl or young woman who expects, whether she admits it or not, to make her stay in business a temporary one. Other things being equal, it is evident that the man or woman who is seriously interested in a particular kind of work will make a greater success than will an uninterested worker.

Employment Methods

Present methods of employing men are based mostly on the use of letters of application, letters of recommendation, photographs, and interviews. A brief consideration of some of the experimental studies of the reliability of these methods of estimating character and ability will be useful here in showing the necessity of adopting more scientific and accurate methods.

Hollingworth reports a study made by Walton of letters of application. A series of letters was rated by different judges for intelligence, neatness, tact, etc., and later some of these same letters were rated by the same judges again. The reliability of these ratings of intelligence, *i.e.*, the agreement of two ratings made by the same judge, for example, varies from .08 to .72 with a median of .61 for 10 judges. In view of this failure of each judge to agree with his own previous rating, it is only natural that they failed to agree very well with each other. A sample comparison of some of the ratings is shown in Table IX, which shows the rankings assigned to 10 letters by 10 judges. However, as these letters are selected from a larger group of 25, the rankings range from 1 to 25 instead of from 1 to 10. Super-

TABLE IX

ESTIMATES OF TEN LETTERS BY TEN JUDGES, TRAIT RATED: INTELLIGENCE

From Hollingworth after Walton *

Judges	Letters									
	A	*B*	*C*	*D*	*E*	*F*	*G*	*H*	*I*	*J*
I......	6	24	13	20	5	3	14	19	12	11
II......	13	15	6	2	5	16	14	17	12	18
III......	2	17	5	22	9	6	13	21	23	14
IV......	11	22	18	13	19	8	20	25	9	16
V......	9	25	19	20	3	5	18	13	16	14
VI......	17	14	25	12	22	3	5	21	20	19
VII......	3	5	9	7	13	1	10	24	15	11
VIII......	4	14	12	17	6	10	13	16	21	22
IX......	11	4	7	18	16	3	5	17	19	23
X......	3	20	9	19	5	8	22	17	18	16

* H. L. Hollingworth, *Judging Human Character,* p. 13.

ficial observation of the table will show that the degree of agreement between the judges is far from high. Estimates of tact and reliability were less uniform than those of intelligence, while estimates of neatness were slightly more so. In no case was very close agreement found.

The value of letters of recommendation is much influenced by the personal attitudes and knowledge of the writers. This gives some an opportunity to vent their spleen on a good man whom they do not like. Others because of personal sympathy do not point out the defects of an inefficient man. Apathy and indifference as to the future fate of a former employee may cause a letter to be colorless and lacking in essential details. Even if the writer does attempt to give a fair and complete statement, there is generally the question of his ability to express his ideas so that the reader will get an accurate idea as to the applicant's qualifications. It is, therefore, not surprising that letters of recommenda-

tion are very unreliable as indicators of a person's qualifications.

Photographs are quite generally used in attempting to estimate the character and qualifications of absent candidates for positions. Several experimental studies of the reliability and validity of judgments based on photographs have been published. The general finding has been that under ordinary conditions photographs are practically worthless as a basis of estimating intelligence. Neither are other traits estimated with sufficient accuracy to make the use of photographs of any real value in the hands of the average individual. A very careful study of accuracy in estimating intelligence from photographs has been made by Gaskill, Fenton, and Porter (1927). These workers had photographs made of 12 boys, all about 11 years of age, and all of distinctly different mental levels with a range of I.Q.'s from 18 to 171. These photographs were then arranged in order of supposed intelligence by 274 students in psychology, the work being done under laboratory conditions. The results of the experiment are shown in Table X. The median correlation between individual rankings and the true ranking is found to be .425. While this looks like a fair correlation, it is in fact of little value as a basis of prediction. Moreover, the conditions of this experiment were much more favorable to accuracy in making estimates than are the conditions ordinarily encountered. Under most conditions, therefore, and with most observers, judgments of intelligence, and of most other traits as well, when based on photographs are practically worthless. To secure the greatest accuracy in such judgments, if they are to be used at all, photographs should be independently judged by a number of individuals who have been selected for such estimating on the basis of having previously demonstrated by actual test that they are able to make such judgments with considerably better than average accuracy. The

TABLE X

FREQUENCIES WITH WHICH 274 JUDGES ASSIGNED RANKS 1 TO 12 IN INTELLIGENCE TO BOYS *A* TO *L* FROM THEIR PICTURES

From Gaskill, Fenton and Porter*

Rankings Assigned	Boys *A* to *L* whose intelligence was judged from photographs											
	A	*B*	*C*	*D*	*E*	*F*	*G*	*H*	*I*	*J*	*K*	*L*
1	11	37	12	2	35	2	92	40	13	1	27	2
2	7	30	35	12	41	3	47	30	16	1	44	8
3	20	28	28	11	40	5	29	41	17	2	39	14
4	17	28	22	22	40	2	34	35	35	3	18	18
5	19	29	20	28	35	14	15	25	33	7	25	25
6	29	24	25	31	31	18	18	26	26	8	28	10
7	26	27	24	26	16	25	12	25	29	6	28	29
8	28	25	27	45	16	24	9	15	31	16	12	26
9	33	17	25	38	12	39	7	13	14	23	26	27
10	27	20	29	33	4	44	6	11	27	34	12	27
11	34	3	15	19	2	51	4	4	24	62	10	46
12	23	7	12	7	2	47	1	9	8	111	5	42
Median rankings	7.3	5.5	6.2	7.8	4.5	9.9	2.7	4.7	6.9	11.4	5.4	8.8
Q	2.4	2.3	2.8	1.9	1.7	1.8	1.7	2.2	2.3	1.2	1.4	2.7
Approximate median class rankings	8	5	6	9	2	11	1	3	7	12	4	10
True rankings by test	3	5	2	9	4	10	6	1	8	12	7	11
I. Q.	128	111	140	55	119	36	99	171	63	18	71	26

* "Judging the Intelligence of Boys from Their Photographs," *Journal of Applied Psychology,* Vol. XI, 1927, p. 397.

average of a number of such judgments would give a more trustworthy estimate than a judgment by one person.

Many who will agree that letters and photographs are of uncertain value will at the same time attach great importance to the value of personal interviews. Many men pride themselves on being accurate judges of the qualifications of men. The only way to determine the accuracy of such

opinions is to submit them to an actual test. Fortunately a number of experimental studies have been made of the accuracy of judgments based on interviews and to indicate the character of the findings we shall give the results reported by Scott and Clothier (1923) for one study.

"Arrangements were made . . . for 13 industrial executives of major rank, each of whom prided himself on his ability in choosing men, from as many different companies, to meet and select the best salesmen from a group of 12 applicants. In doing so, each was directed to interview each of the 12 applicants privately, use whatever procedure or method he wished, then to rank them from 1 to 12 in the order of his preference."[1]

The results of this study are shown in Table XI. A study of the table shows that applicants II and IV were ranked all the way from 1 to 11; applicants III, V, and VIII were ranked from 1 to 12; applicants VI and VII were ranked from 2 to 11; applicant IX was ranked from 2 to 12, applicant I from 1 to 9, applicant XI from 4 to 12, applicant X from 5 to 12, and applicant XII from 8 to 12. This last case showing a range of 5 places is the most uniformly rated of the 12 applicants. Surely this is far from showing accuracy and consistency in such ratings! Evidently there is room for improvement in this method of selecting applicants.

The failure of customary methods of selecting and employing men and the demonstration that in many cases such selection could be made more economically and accurately by psychological tests has led to considerable effort to develop and apply such tests. To a consideration of these we shall now turn.

There are three main steps in the application of psychological methods to employment. Firstly, it is necessary to

[1] W. D. Scott and R. C. Clothier, *Personnel Management* (Chicago, A. W. Shaw Co., 1923), p. 24.

TABLE XI

TABLE SHOWING RESULTS OF SELECTION EXPERIMENT AMONG THIRTEEN EXECUTIVES

From Scott and Clothier *

Appli-cants	Firm Rank	Median Inter-view	Interviewers												
			A	*B*	*C*	*D*	*E*	*F*	*G*	*H*	*I*	*J*	*K*	*L*	*M*
II..	1	2	5	4	11	1	4	5	3	2	1	4	7	4	8
IV..	2	4	1	1	7	3	5	9	11	4	2	3	7	5	2
I..	3	1	8	8	3	4	6	1	1	1	4	3	2	7	9
III..	4	3	2	8	1	2	9	2	6	12	5	6	4	1	1
VIII..	5	8	6	2	2	5	1	12	10	9	6	7	6	6	7
V..	6	5	3	12	6	5	8	7	5	10	3	3	1	3	2
VI..	7	6	7	7	10	8	2	3	4	5	8	3	3	11	4
VII..	8	7	9	3	8	11	7	4	2	3	11	9	5	2	5
XI..	9	11	4	6	12	7	9	11	8	6	10	12	9	12	12
IX..	10	9	11	10	4	8	2	6	12	7	7	11	12	9	6
X..	11	10	12	5	5	10	11	8	7	8	9	8	11	10	10
XII..	12	12	10	11	9	12	12	10	9	11	12	10	10	8	11
Correlation of each with median of interviewers			.50	.11	.26	.80	.34	.69	.55	.45	.82	.84	.67	.58	.47
Correlation of each with firm rank....			.50	.33	.16	.89	.02	.19	.27	.33	.84	.76	.25	.40	.21

Correlation of firm rank with median of interviewers............85

* W. D. Scott and R. C. Clothier, *Personnel Management,* p. 25.

analyze the job and determine as nearly as possible the physical and mental capacities necessary to do the work successfully. For this purpose it is desirable though not always necessary for the psychologist to do the work himself until he becomes familiar with it. This will usually facilitate the analysis of the capacities necessary for really successful work. Secondly, it is necessary to devise and standardize a number of tests that will correlate satisfactorily with performance on the job. This requires considerable experience with psychological experimentation and

especially with mental and physical tests and measurements. It is necessary to get a test on which successful workers make high scores and on which unsuccessful workers make low scores. Ordinarily in any particular kind of work it will be necessary to use a number of tests since more than one kind of ability is usually required. When a battery of tests has been validated and standardized it is ready for use. Thirdly, the tests are used by the employment office in determining what applicants for a particular position are best suited for the work. This is a relative matter: the larger the number of applicants, the greater the probability of getting a satisfactory employee. In practice there may be a passing score on the test so that those below that figure are rejected and those above are employed, but generally speaking the relation between supply and demand would also be an important factor in determining the critical score.

To illustrate the actual working of such methods we shall consider some results secured by Link (1919). During the War, Link undertook to devise tests that would select workers in an ammunition factory. Eight tests were given to 52 shell inspectors and 21 shell gaugers. Correlations were then worked out between these test results and the actual production records of the workers. The results for 5 tests were as follows: [2]

Tests	Correlations	
	Inspectors	Gaugers
Card Sorting	.55	.05
Tapping	.14	.52
Cancellation	.63	.17
General Intelligence	.14	.18
Number Group Checking	.72	—.19

[2] H. C. Link, *Employment Psychology* (New York, Macmillan, 1919), p. 35.

This shows that 3 tests would be useful in selecting inspectors but that only one of this group would be useful in selecting gaugers. And interestingly enough the Tapping Test, which shows the highest correlation with gauging, shows a low correlation with inspecting. Thus a person might succeed at one kind of work and not at the other. The tests make it possible to learn this fact in a few minutes without having the worker waste a lot of time at the wrong job.

We must, of course, not expect the adoption of psychological tests to cure all of our employment problems. Even with the most careful testing, mistakes will still be made; but experience has shown that it is possible in many kinds of work to make the employment department work much more efficiently by use of tests. In mechanical work the results may be expected to be better than in work involving personal relationships. In secretarial work, for example, there is not only the question of doing efficient work; there is the additional problem of making purely personal adjustments to the particular employer. Some employers cannot endure red hair, others have a marked dislike for protruding teeth, etc., etc., *ad infinitum*. Now no system of tests will ever be sufficient to eliminate all candidates having characteristics objectionable to the different employers but not relevant to the work. To the extent, therefore, that personal factors enter into the rating of employees, it is not to be expected that tests will be successful.

Shifting of Employees

Many men are doing satisfactory work in a particular job when they are capable of doing work of a more difficult and more responsible character. Under such circumstances it is clearly wasteful to keep them in the inferior kind of work. Many, perhaps most, of these men do not have any very definite idea of their ability and therefore need

some encouragement to bring out what they are capable of doing. It is to the interest of the employer to discover these men by means of tests and then give them the training and promotions to which their intelligence entitles them.

Shifting of men may also be useful within a particular department, as from one machine to another one, in order to get them placed more in accordance with their special abilities. The alert personnel officer can add much to productive efficiency by such methods.

Promotions

Under present conditions personal likes and dislikes enter to an undue extent in determining promotions. The same kind of increase in efficiency could, therefore, be secured by making promotions more scientific as is secured by placing employment on a scientific basis. There is perhaps less danger of serious error in case of promotions, but such evidence as we have on the matter shows that an undue number of men of relatively inferior intelligence are holding important positions. This is not only a cause of inefficiency because of the inability of the men in question, but it has a bad effect on the morale of the associated workers, for these can be counted on in many instances to recognize the inferior capacities of the inferior men who are promoted. When it is recognized that promotion is not on the basis of merit and accomplishment, one of the most powerful stimuli to extra achievement is lost.

Adjustment of Pay

Closely related to the effect of promotions but more general in its effect is the question of equalization of pay for work of the same difficulty with equitable differences in pay for differences in work. Generally speaking, wages and salaries are controlled by supply and demand and it has been commonly assumed that the proper policy for a busi-

ness is to get the necessary men at the lowest price possible. Such a policy, however, overlooks fundamental human characteristics and leads to inequalities and injustices which are certain to impair the morale of any business organization. Men of less ability and training are paid more simply because it happens that at the time there is a greater demand for their particular kind of ability or training. This is resented by others who merit as much or more, and the inevitable result is a lowering of productive efficiency. Some exceptional business organizations have shown that it is possible to disregard the customary attitude towards supply and demand, and by paying more than the average wage and by giving attention to the problem of fair adjustment of wages they have secured a degree of efficiency which has more than compensated for the wage increases.

Discharges

The methods of discharging unnecessary or unsatisfactory employees have in the past tended to be as objectionable as the methods of employing them. In many cases men have been "fired" simply because the foreman or other superior under whom they happened to be working became angry and chose to show his authority in that manner. In some cases discharge in such fashion has been little more than a method used by the "boss" of satisfying an inferiority complex. He has realized that the man working under him was a superior man and as this led to an uncomfortable feeling the discharge was the natural result. However, industrial efficiency demands the control of personal likes and dislikes: the problem of discharges must be handled on the basis of merit. Large corporations have recognized this fact in many cases and have taken from the foreman his power of discharge. If the foreman finds a man unsatisfactory, he has the right to report that fact for investigation by the proper department, but he may not discharge

the man in summary fashion. When one considers the seriousness to many men of a summary discharge, the justice of limiting the foreman's power in this direction is evident. The psychology of individual differences does not justify the blind faith in the acts of foremen and other supervisors that has usually existed. To this must be added a recognition of the fact that even the meanest workingman has certain rights and deserves some consideration. No reasonable ethical system can assign all of the rights to the employer and all of the duties to the employee.

However, disregarding abstract questions of ethics, economic efficiency is impossible without satisfactory morale, and morale cannot be maintained without giving reasonable assurance to workers that they will not meet with summary dismissal simply because the "boss" is displeased. The problem of discharge must be handled in a scientific manner by competent men who will be governed by facts and not by personal prejudices. That a revision of policy is taking place in this direction by large corporations is in itself a strong indication that it is a wise business policy. The divine right of kings with its attendant idea of infallibility has passed and in due course we may expect the passing of the idea of infallibility and divine rights of lesser "kings." The principle is the same in both cases.

Adjustment of Position to Man

Thus far we have considered the problem of industrial adjustment on purely one side: the adjustment of the man to the job. There is, however, the reverse possibility of adjusting the job to the man. Some kinds of work may be relatively inflexible and it may not be possible to carry this adjustment very far, but in other cases much can be done in the direction of promoting efficiency by adjusting the requirements of the job so that the man can more readily make the necessary adjustments. There is no *a priori*

reason why the man should do all of the adjusting. There is a limit to which human adjustments can be made and all adjustments involve work, strain, expenditure of energy. It must therefore be evident that a point of diminishing returns will be reached where the process of personal adjustment will be unprofitable and where the man will fail to meet the requirements of the job unless the job is itself modified. If the man is a good worker, there is no reason why his individuality should not be respected and allowed for to a reasonable degree. Mechanization and standardization are desirable and even necessary in many instances, but where they are not necessary increased efficiency will often result by giving due consideration to the facts of individual differences.

Effects of Unionism

Originally the labor unions developed as a necessary means to secure something like fair treatment for the laborers from their employers. In so far as they have functioned for that purpose and to that end they should receive only praise. Unfortunately, however, the unions have tended to support certain ideas that are incompatible with the facts of human nature or with the legitimate requirements of industry. They have endeavored to regulate the output of workers so that this would be uniform instead of varying according to the curve of distribution. At the same time they have endeavored to enforce uniformity of pay regardless of differences in quality of output. In order to get away from the real issue they have often advanced the principle that the worker was selling his time only and that he had no responsibility for production; that was up to the employer. If this unit is accepted, then there is naturally no difference in the accomplishment of different men: all live exactly twenty-four hours daily. In line with this emphasis on mere duration they have emphasized seniority

as a basis of promotion. Thus the main tendency of such organizations has often been away from an encouragement of the innate differences between men. The idea has been rather to reduce the superior man to the level of low mediocrity. The most active advocates of these ideas and the ones who profited most by them have, of course, *not* been subject to the rules, nor have they drawn the pay of the ordinary members: rather they have in general received very handsome pay for their initiative, intelligence and leadership.

This is not the place nor has the writer the desire to attempt an evaluation of unionism in general; but it is within the scope of applied psychology to point out the necessity of adapting our institutions to the elementary facts of human nature. In view, therefore, of the known facts of individual differences, it should be evident that any attempt to cast all men in the same mold is subversive of the best interests of those involved and is doomed eventually to fail. It is the nature of man to find satisfaction in achievement and what is easy for one man is difficult for another. For work to be satisfying there must be some adjustment between its difficulty and the capacity of the worker. Naturally, then, any attempt at uniformity must necessarily be unsatisfactory to many who deviate from the established norm of performance. Under some conditions uniformity is from the nature of things imperative, as, for example, in the marching of troops; but here it must be recognized that the rate of the column cannot be above the rate of the slowest member. Here those capable of faster progress must be held back. Where there is no necessity for such restriction there is no good reason for attempting its application, and there are excellent reasons, both economic and psychological, for refusing to be so handicapped. If, then, unionism is to survive, it must adapt itself to the facts of the psychology of individual differences. It must make a

place for ambition and initiative. It must enable the intelligent and the capable man to pass in the economic race the man who is unintelligent or incapable or slothful. To summarize: there are four principles which must be adopted by unionism if it is to be made acceptable from a psychological point of view. First, there must be no restriction to individual effort; each man must rather be encouraged to do his best. Second, compensation must be sought on the basis of work accomplished rather than on the basis of time served. This means compensation according to ability and effort. Third, there must be no restriction on the number of apprentices. Every man must be equally free to attempt a given kind of work. And fourth, promotion must be on the basis of merit rather than on the basis of seniority.

PRODUCTION AND SELLING

Adjustment of Production of Articles to Individual Differences

A visit to a bargain sale of wearing apparel will usually reveal the fact that there is an excess of large and small sizes. The same condition has often been met in military depots where recruits are given their outfits. After the supply begins to be depleted, there often remains an excess of large and small sizes of the various articles of clothing. This suggests the need of a study on the part of manufacturers and clothing salesmen of the actual distribution curves of sizes of different garments. If the matter were carefully and scientifically studied, there should be no excessive supply of extreme sizes left over. It should be easy for any large concern to adjust its stock to the distribution of sizes of its customers, and if this were done, a different picture would be presented by the mid-summer or mid-winter clearing sale. This is, of course, not a matter of psychology; but it may be used to illustrate a principle that

may be expected to apply to things more in the field of mental differences.

There are differences in color preferences, for example, which will necessarily influence the sales of articles in which color is a factor. Children's toys are painted red on the assumption that red will be more attractive to them. With very young children this is a questionable assumption. These preferences change with age, but some degree of regularity in the distribution of the preferences of adults of given levels of intelligence could be expected, and it would be to the profit of clothing manufacturers and others dealing with colors to make a scientific study of the problem.

Thus far there has been no adequate recognition of the existence of innate differences which could be systematically investigated and described, and as a result such problems have not been worked out. In a rough way, of course, demand has regulated supply, but the whole matter has proceeded generally without a recognition of the underlying principles.

Advertising and Selling

The most important contributions of psychology to advertising and selling have not come from the study of individual differences. There has, it is true, been a great deal of pseudo-psychology taught to would-be salesmen on the arts of sizing up men, etc.; but as we have seen in earlier chapters, the methods of sizing up prospective buyers are open to the same objections as are the methods of employing men on the basis of interviews, photographs, etc. Theoretically it would be highly desirable to be able to look at a man and judge from that the best method of selling him an article, but science is not at present able to lay down rules of thumb by which that can be done. It is, however, possible to make some contribution from the study of individual differences to the theory and practice of advertising and selling.

Particular products are often intended for buyers of a more or less limited intelligence distribution. Certain patent medicines will probably be bought mostly by people of average and less than average intelligence. Books of certain kinds will be bought almost exclusively by people of superior intelligence. Under such conditions it will be profitable to adapt the advertising to the intelligence of the prospective buyers. This is done in fact with considerable success.

The appeals used in advertising also offer possibilities of variation to secure greater adaptability to individual groups. Some articles are bought by women, others by men, and in such cases differences in interests may be considered. Age differences, and even race differences, in interests may also be used as a basis of appeals. In advertising special articles, class differences may also enter, though in a country such as ours the possibilities in this direction are limited. Differences between the averages of groups are likely to be less than the differences between individuals in a group and for this reason the results of the study of individual differences have a rather limited application in the field of advertising, but though limited the applications are nevertheless important.

Selling directly to the buyer offers greater opportunities to the salesman with the art of understanding differences in buyers. It may be possible in this case to modify selling talks and procedure so as to secure much better results, but little of concrete practical importance can at present be said.

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CHAPTER XX

APPLICATIONS TO LAW AND GOVERNMENT

Early Governments

Among primitive peoples the government of a tribe is usually in the hands of a group of chiefs with some one chief as the leader. Physical superiority is in such cases the chief basis of leadership, though it must also be supported by courage and other more mental qualities.

Until relatively recent times a very close relation has existed between military leadership and civil leadership and for this reason the official heads of governments have usually been fighters. And even under present conditions the prestige of the fighting man is very great, though there is an increasing tendency to select other men as government leaders.

In all cases, however, it is evident that government has been in the hands of a limited class of men who have been superior to the mass of the population in certain respects. Originally the superiority was primarily physical, but at present the emphasis among civilized nations is on mental and moral traits, though the purely physical aspects can hardly be said to be without great influence.

Forms of Government

Autocracy.—The typical autocratic government of relatively recent times has consisted of a king who held his position because of hereditary descent and who had considerable power, and an advisory body consisting of nobles also holding their position because of hereditary descent, and

sometimes other advisers. In some contemporary monarchies the king has very little real power, but in the older ones his power was often absolute.

Individual psychology has several important bearings on the theory of autocratic government. On the favorable side it may be said that the original king was made king because he was found to have certain desirable powers to a greater degree than the rest of the population. He was, therefore, better fitted in certain respects to rule than were the remaining members of the group. Also on the favorable side it may be noted that placing great power in the hands of one man is a surer method of securing speedy action and action directed towards one goal than is the method of placing power in the hands of a group of men, because due to individual differences it is not to be expected that a group will agree sufficiently to devise and carry out a policy with great speed and persistency.

There are, however, more objections to autocracy than arguments in its favor. In the first place, every individual suffers from the limitations of his native capacities and his experience. On the side of experience, especially in an autocratic government, there is the grave danger that the autocrat will think of the government primarily from the point of view of his own desires or of the desires of his own class or caste. In such case the interests of the people will almost certainly suffer. They will become little more than beasts of burden to do the will of the king and assist in providing him with what he desires. The same general result, it should be kept in mind, follows in all kinds of enterprises where authority is placed in the hands of one man. The exceptional man may be sufficiently interested in the welfare of his subjects to give a great deal of consideration to their needs, but there is no guaranty as to the extent to which this will take place. Ordinarily the king is surrounded by advisers from the nobility and so the advice he receives will

also usually be inimical to the best interests of the people at large.

Even though we grant, however, that the autocrat is sincerely attempting to do his best in providing for the people rather than for himself, the objection must be raised that no man is infallible. The king may be well informed and may have excellent judgment along certain lines and may reach sound conclusions in dealing with such problems, but that is no guaranty that along other lines his information and his judgment will be such as to lead to similarly satisfactory results. One has only to do a little thinking to recall various successful leaders in particular activities who have failed ingloriously in other activities. The same must often hold of all kinds of autocrats. They may be successful along some lines because of exceptional ability in that kind of thinking and activity; but it is extremely unlikely psychologically that all of their abilities will be equally superior, so when they attempt different problems it is a foregone conclusion that they must often fail. The correlation between different abilities is by no means unity, and at times it is negative. There is no biological guaranty that kings will escape this possibility of negative relationship, and when they do possess inferior abilities the results may be exceedingly serious. This is in itself a sufficient argument against any kind of absolutism where the public is involved.

A further argument against hereditary autocracy, whether absolute or limited, lies in the fact that the mechanics of heredity does not afford us a basis for predicting with any degree of certainty just what the son of a particular man will be like. To this must be added two chances: first, that if the king is really very superior himself his wife will be inferior and so will contribute to an inferior son, and secondly, the general tendency to revert to type, Galton's law of regression. Both of these probabilities are sufficiently serious to make hereditary kingship objectionable and when

we consider the possibility that the son of a satisfactory king may inherit a combination of dubious recessives the objection becomes all the more weighty.

The same arguments urged against a hereditary kingship apply against the whole idea of hereditary nobility or any kind of a fixed caste. There are great differences in ability and these differences appear to be hereditary, but the mechanics of heredity is not such that the son is in any sense a replica of the father. It is on this point that the primary objection must be raised to the inheritance of a title of nobility. The determiners that made the father "noble" may be absent from the son.

Democracy.—There have been few examples of real democracies. Usually the democracy has functioned by means of representatives and so may more appropriately be called a republic. In a strict democracy a number of difficulties would arise because of individual differences. Firstly, the differences in desires, opinions, knowledge, etc., would make agreement on any policy slow and difficult of attainment. It would be a hopelessly cumbersome method of government in any large group: Indecision and petty strife would be its essential characteristics. Such was the case in ancient Greece. But more important than this, in any real democracy there would be the difficulty of the low level of intelligence of a considerable part of the population. If one accepts the facts of individual differences, whether he bothers with the results of the Army tests or not, or of other investigations bearing on the mentality of the general population, it must be an acceptable statement to say that problems which the superior members of the population understand and can solve are beyond the masses. Even if we deny differences in native mentality, the same result would follow from differences in training. There are many problems which the public at large is not prepared to solve but which can be solved by experts. This is an

inherent and at times a serious danger in any attempt at democratic government. It is less serious in a representative government but is by no means lacking, as we shall see later.

The mental level of the population has a very important bearing on the question of whether a democratic or republican form of government can be made a success. Only intelligent peoples can be expected to make a real success of such a government. This is in itself a sufficient explanation of the difficulties of some governments. This has also a vital bearing on the opposition of the South to granting the vote to the Negro. The South does not believe the Negro is able to vote as he should be able to vote and for that reason opposes the ballot. The logical extension of this principle would, of course, cause it to be applied to many whites as well, and it is quite within the bounds of possibility that we may eventually come to the adoption of some adequate test of intelligence and understanding of government as a basis of the exercise of the ballot. But in that case the government would be to that extent less democratic.

The shift from pure democracy to representative republicanism reduces materially the dangers we have pointed out, because the elected representatives are ordinarily of more intelligence and in any case are fewer in number and so are a less cumbersome body. This is, of course, the form in which modern democracy has expressed itself. We shall consider more in detail certain problems related especially to that kind of government.

Economic Policy

In economic policies governments have varied from extreme individualism to communism. The psychology of individual differences has an important bearing on the theoretical merits and defects of such systems and so on the

probability of their practical success or failure, which just now is a vital question.

Individualism.—Under the influence of the doctrine of individual equality an extreme condition of individualism in enterprise was permitted by some governments. Extreme competition and powerful combinations were the results. To those who had, more was added, and those who had nothing were reduced to a condition of want and debt. Wealth and poverty grew side by side. Thus was expressed in an economic form the inevitable result of innate differences in ability exaggerated by the added differences due to environmental opportunity. The injustice of such uncurbed competition and individualistic enterprise was finally realized and restrictive measures have been attempted with the idea of protecting the public and the weaker business enterprises from the results of the voracious rapacity of powerful individuals and combinations.

The logic of the above situation is evident. Individuals are not equal in ability and with great freedom of action permitted it was an easy matter for the strong to crush the weak. Thus was refuted the very principle on which individualism in industry was based.

Socialism.—The reaction from an extreme individualism led naturally to a more paternalistic form of government. Since some individuals were capable and greedy, it was necessary to curb their power and regulate their activities. This was especially true in essential industries, and from this arose the conception of public ownership and operation of utilities and other plants where competition could not exist in any satisfactory way. But the difficulty has arisen here that the public has proved a poor master and the management of such enterprises under public ownership has lacked the motivation to superior achievement which is provided by private ownership. Herein lies the essential difficulty of socialistic schemes. Individualistic enterprise has

in the past been more progressive and it may well be impossible to secure the same efficiency and progress under public ownership and control.

Communism.—The extreme reaction from individualism is found in communism. Strangely enough, the theoretical view of human nature underlying this form of economic policy is often the same as that underlying extreme individualism, *i.e.*, that all men are equal in rights and powers and that it is only the chances of environment that make them unequal. The difference between the two views lies in the fact that the individualist stresses enterprise and effort as the explanation of the differences in achievement, while the communist stresses differences in luck and opportunity. The individualist believes, therefore, that what each man gets he should keep, while the communist believes that there should be strict equality in the enjoyment of goods.

From the viewpoint of the psychology of individual differences the theory of communism is clearly untenable. Men are not natively equal in capacities or in desires. An equal distribution of wealth would in effect be an unequal distribution, because the factor of subjective valuation is the important thing to the individual and different individuals would not place the same valuation on objectively equal amounts of goods. The result would be that some would be content or more than content while others would be entirely dissatisfied. Because of this fact it is quite impossible to supply adequate motivation to mankind in general by making the results of effort equal. The individual of superior ability will refuse to do work of greater responsibility and skill unless he receives a correspondingly greater reward.

Differences in abilities and in likes and dislikes are inborn and ineradicable—though not, of course, unmodifiable —and under such conditions no economic system will be workable which does not provide for differences in the re-

wards of effort. Consider, for example, the problem of housing. Some men are quite content to live in shacks. They would rather rest at ease than to put forth enough effort to earn money to buy paint to paint their houses. The proof of this is found in any long drive through the country. So with other things. If in an attempt to equalize conditions we razed all the houses now standing and erected a series of uniform structures, it would still be necessary to enact and enforce regulations regarding their care in order to keep them equal. Otherwise in a short time some would be dirty and in poor repair while others would be in the best of condition and would be surrounded by vines and flowers.

The private soldiers in an army are more nearly in the position aimed at by communism than any other group. Their duties and their pay are equal; they wear the same kind of clothes; they live in the same kind of tents or barracks; they go to bed at the same time and get up at the same time. But such equality in a group is brought about only by having a superior group to enforce the equality. This shows convincingly that the communist ideal is impossible with men as they are. It never has worked and never will. There need be no serious fear that it will ever spread very far among an intelligent people.

Political Parties

Political parties are partly economic and partly psychological. On the economic side we have such questions as the tariff as the dividing line. This is a matter of occupation and not of psychology. On the psychological side the outstanding basis of classification is conservatism and liberalism. We should not make the mistake, however, of supposing that the population can be classified into those two groups. It seems probable rather that these represent the two extremes of a distribution with the great mass of the population at a midpoint between. Statistics of the

voting at important elections would seem to support this conclusion; for while many ardent advocates and opponents make a great deal of noise over the election, it often happens that the majority of the people stay away from the polls and do not vote. They are indifferent to the result.

In view of the facts of individual differences it is but natural that parties representing extreme views should develop and that the average citizen should be neutral. The same applies to many specific political or governmental policies: some are violently for and others are no less violently against, while the average citizen looks on without great concern. When psychological factors are at the basis of parties this is to be expected, but when economic factors are the basis we may get a very different result. In practice, of course, both psychological and economic factors are involved and the analysis is rendered correspondingly more difficult.

Branches of Government

The Legislature.—Passing laws is one of the chief national sports in the United States. They are ground out at such a terrific rate that even the professional lawyers and politicians often do not know what is the law and what is not. It is frequently necessary to have them interpreted by court action to tell just what they do mean. When we compare the acts of different state legislatures, we find the widest diversity in the regulations covering the same thing. Also we find laws of all degrees of rationality. One legislator proposed a bill to change the value of *pi* from 3.1416 to 3.0000. More than one legislature has declared the theory of evolution untrue and prohibited its being taught. Our marriage laws are so divergent that a man can be a bigamist in one state, an unmarried man in another state, and the husband of one wife in another state. Such a condition in

the proceedings of our legal bodies would seem to require some explanation.

The evidence at hand leaves no doubt that the level of education of the citizens of different states is unequal, and the mental testers will go a step farther and say that the evidence shows that the intelligence of the populations of different states is not the same. Furthermore, the members of the state legislatures can hardly be said to be selected as a group on the basis of intelligence and education. Many men of distinctly inferior ability and little or no training are elected to such positions. And even those of greater ability and training are too much influenced by the opinions of their voters to pass an independent judgment on prospective laws. The first duty of the politician is usually conceived to be to stay in politics, and this means that he must vote as his constituents think. This makes for representative government but not necessarily for intelligent or stable or progressive government. Too much of the psychology of the crowd is introduced.

Under such conditions a wide diversity of laws is the natural result. Laws are passed to please noisy minorities when the silent majority is opposed to the law. When the law is passed it will, if convenient, be forgotten—at least the legislature has done its duty.

The remedy for such a state of affairs must lie in the election of men of greater ability to handle our legislative problems. At present there is not sufficient inducement for the best men to enter politics, and we are reaping the very logical result. If we want more intelligent laws, we must first have more intelligent and better qualified legislators.

Among the current practices in the making of laws is generally found one to the effect that it is necessary to have a majority of only one vote in order to pass a law. In some cases the application of this principle is palpably absurd. Suppose, for example, we have a popular referendum on

some particular measure. Out of 100 potential voters we may have votes cast by only 25 (or even less). Suppose it happens that 12 of these votes are against the measure and 13 for it. In such a case by virtue of a majority of 1 vote, or by a vote of 13 per cent of the total, a measure is thrust upon the remaining 87 per cent of the population. To say that this is perfectly fair because the ones who did not vote should have done so is beside the point. The objectionable thing is that it is so easy for a minority to make laws. If we really think we have too many laws, we should make it more difficult for minorities to pass laws. Instead of a majority of one we need some considerably higher number, such as a two-thirds majority, and in popular referendums it would not be inappropriate to require that some definite large percentage of the potential voters actually vote for the measure in order to pass it. If they remained at home and did not vote, that should be taken as sufficient proof that they did not care for the measure.

In order to avoid deadlocks on necessary measures some distinction would doubtless have to be made between the requirements for the passage of different kinds of bills. But as regards the passage of new restrictions and regulations we are greatly in need of efficient safeguards to protect even the majority of the people. Supposing, however, that a majority of the people actually desired a given measure, there should be more restriction on the power of the majority to impose their will on minorities. If, for example, it happens in a particular case that a majority of the voters belong to the group of fundamentalists who accept the naïve ideas of mediæval philosophy, it should be much more difficult for them to impose their will on an intelligent minority.

The general point to be made here is that we need a new conception of the purposes and limits of laws. Our present conceptions and practices are the product of an antiquated psychology which did not understand or recognize the vast

extent of the innate differences between individuals. When these are understood the only legitimate thing to do is to amend our practices in such a way as to allow as much freedom to the individual as can be allowed without injury to the social group. This is the central idea back of the suggestion that we make it more difficult to pass laws.

The Executive.—Nominally the executive is supposed to carry out the will of the people as expressed by the legislature. Actually he is usually given considerable latitude in carrying out many measures. It is this aspect of the executive's work which is of interest to the individual psychologist. The principles pointed out in the discussion of the autocrat apply here also. A wise autocrat can accomplish more and in shorter time than can a body of equally intelligent men, but the unwise or unscrupulous executive can do an equally great amount of damage. It is a matter of record that in more than one instance where states have spent many thousands of dollars getting criminals behind the bars the executive has turned them loose. Another executive would have kept them in. In many other matters where important decisions are left to the one man, the result is a matter of chance: one man would do one thing and another man would do the opposite thing. A superficial consideration of the facts of individual differences would require that such farcical performances be stopped as far as possible. The judgment of one man is too unreliable to be trusted with the settlement of matters of vital importance to the people at large when the decision arrived at is subject to the uncertainties of personal opinion. As an executive, strictly speaking, one man may be very satisfactory, but as an interpreter of laws he must be unsatisfactory, and still more unsatisfactory must be the placing in the hands of one man of the power to set laws aside. The American system of government still suffers unduly from this kind of abuse of power. Our ex-

ecutives are entirely too powerful. And being human and fallible they naturally abuse their power.

Much the same situation exists in other fields, as business and education. Problems of great consequence affecting the public at large are left to the discretion of single individuals. The result under such circumstances is entirely too much a matter of chance.

Psychologically, the explanation of a considerable part of this entrusting of important affairs to the chances of one man's opinion lies in the failure to understand that capacities are specific and not general. When a man succeeds as a military commander, it is taken for granted that he is equally able to succeed in other lines. The psychologist knows that this by no means follows. In fact there may well be a presumption that the man trained and adapted to a military life will because of that fact be found poorly adapted to the adjustments and compromises required of a civil leader. Certainly the problems of a President of the United States are not the same as those of a military leader, and the training that fits for one position is not the best training for the other. Despite this, however, we have had numerous military presidents and probably shall have more. In some cases, it is true, we do not go to such an extreme position. We do not credit a good lawyer with being able to treat disease or a good physician with being able to try a case at law; but we do go entirely too far in our confidence in the uniformity of abilities and knowledge.

In matters where personal opinion does not enter to a great degree, where conclusions are reached on the basis of technical principles, a decision may usually be left to one qualified man, because other qualified men under such conditions would reach the same conclusion. Also when a decision is not of great importance, it may be justifiable for the sake of economy of effort to leave the matter to one man. And again when speed of decision is an important

requisite, as in a military campaign, it may be necessary to have one man in authority, even though it be recognized that costly errors will necessarily result from time to time under such a system. Under other conditions, however, the leaving of important decisions to one man is a costly and inefficient procedure in the final results. The prudent man will not even make important decisions affecting only himself without first securing outside advice if it is available, and in public matters the powers entrusted to one man should be strictly limited.

The Judiciary.—It is an interesting commentary on human consistency that a people who pride themselves on being free from the yoke of arbitrary kings should have set up as a part of their government a judiciary with the very powers from which they have rebelled. Under present conditions questions of life and death are left to the chance moods and opinions of a single man. There is no room for doubt that in the latitude left to individual judges we are placing men brought before the bar of justice in a lottery. If the judge is kind-hearted and likes the defendant's looks and the crime is not too serious, there may be no penalty at all, while if a different judge were trying the same case, a sentence of several years might result. We have only to read the daily press for a few days to find cases where different judges have reached opposite conclusions on the same matter. Such a condition clearly requires a revision of our legal system in such a manner that individual differences in judges will not be of such vital importance in determining the result. Autocracy in the judiciary may be quite as objectionable as in other places.

Enforcing the Laws

Juries.—The jury system was once a great improvement over previous methods of determining guilt. It contained important safeguards against the arbitrary exercise of power

on the part of one man. Thus far it was good. It would seem, however, that the hour has arrived when more efficient methods might well be developed for handling the same problem. The weighing of evidence in difficult cases is not a problem for ignorant amateurs. Yet our methods of selecting jurors tend to favor the selection of those who are both ignorant and stupid. We advertise the details of cases for months and even for years and then excuse from jury service those who have been mentally alert enough to read about the case and form an opinion on it. Serious objection may also be raised to the practice of requiring a unanimous decision on the part of the jury. The facts of individual differences are against such a practice. One or two jurors, because of eccentricity or fraud, may prevent justice just as readily as a single judge may do so. Our jury system must be revised if we are to deal effectively with criminals. The present system protects criminals but does not protect society.

Testimony.—The experiments of Stern and others have brought out the fact that reports of observations are ordinarily only partly true. Even scientifically trained men do not report ordinary occurrences with accuracy. When excitement is a factor, the accuracy of observation and report is still less. Differences in suggestibility play an important part in determining what a person thinks he sees. The weighing of evidence of which testimony is an important part is therefore a very difficult matter and it is essential that such evidence be passed upon by trained and experienced people if serious errors are to be reduced—they probably cannot be avoided. The first essential, however, is a recognition of the existence of great individual differences in accuracy of observation and testimony with a strong tendency in the direction of inaccuracy.

Police Officers.—Only a limited amount of evidence as to the intelligence of police officers is available. The conclu-

sion from such evidence is that as a group they average a little above the average of the general population but with a rather wide distribution. There appears to be a strong tendency for superior men to avoid such work or to get out of it in case they happen to get into it. However, the work of catching clever criminals requires intelligence of a superior order and sufficient inducements should be offered to cause men of high intelligence and character to enter the police forces.

Statistics of criminals often show them to be of inferior intelligence as compared with the general population, but statistics also show that a large number of criminals are never caught, and from this we may reasonably infer that it is the more intelligent criminals who escape. They are the more dangerous ones and the only way we can hope to apprehend them is by having a larger number of intelligent men in our police departments.

Effect of Governmental Inefficiency on Crime.—The German philosopher Fichte once said that the purpose of government is to make itself unnecessary. Presumably the success of a government might be determined by the extent to which it had reached this goal. Yet if such is the case, American citizens can hardly regard their own government with excessive pride. Crime flourishes here to a much greater extent than in other equally civilized countries. Conditions are, of course, not the same. Our population is different and has a different background. This, however, is an entirely inadequate excuse for the present disgraceful conditions.

Lack of respect for the government is based largely on governmental deficiencies. We make too many laws, and too many laws are foolish or unnecessary or unjust. And when the laws are made their enforcement is largely a matter of chance and influence. Many factors enter here but individual differences play a large part in determining the

result. From this it follows that a satisfactory readjustment of our legal system can only be made on the basis of a more nearly correct psychology.

Laws by and for Lawyers.—One of the chief causes of governmental inefficiency in dealing with crime is the fact that the existing system is a great benefit financially to the lawyers, and as our laws are made by legislatures composed mostly of lawyers there is naturally little disposition to change the system of dealing with criminals in such a way as to secure quick and certain punishment for them. To do this would eliminate the numerous additional fees received from appeals and new trials. It is too much to expect that the law-making lawyers will be so disinterested as to cut off this rich source of revenue unless the public at large forces such action. Some thinkers have already warned the public that there are entirely too many lawyers in our law-making bodies and it is a timely warning. Only a superficial knowledge of human nature is necessary to realize that, when any one class is in control, we are certain to have class legislation favoring the class in power. If our legislatures were composed of ministers, it may safely be assumed that we would have class legislation of a different kind. If only farmers were in the legislatures, it would be still a different kind of class legislation; and so for any other class. Since crime is a matter of great public interest, it is evidently a grave error to leave the problem of crime control in the hands of a class which profits from crime.

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CHAPTER XXI

MISCELLANEOUS APPLICATIONS

Individual Hygiene and Efficiency

In medicine it has not yet been adequately realized that there are great differences in the constitution of individuals and hence that adjustments must be made in treatment in order to secure the best results. Yet we have excellent reasons for supposing the existence of the same kind of variation in the physical and the mental fields. The problem of physical hygiene is important to psychology, because mental efficiency rests on physical efficiency. It is, then, worth our while to note here that there are great individual differences in the fundamental biological requirements of food, exercise, and sleep. What is suited to one person may not be at all suited to another. Drugs do not affect all alike. One man is helped by drinking coffee while another man is injured. Susceptibility to fatigue, both mental and physical, varies greatly. The eight-hour day may be too much for some while others could easily do more. Individual efficiency thus requires that physiological principles be adjusted to specific constitutional differences in men.

In general, we may say that mental hygiene requires varied stimulation and proper activities to provide outlets for emotions and other tendencies. Much factory and office work is monotonous and the individual requires outside activities to provide this varied stimulation and opportunity for response and for individual development. Yet what is needed by one man is clearly not best for another. The manual laborer may profit most by avocations requiring

mental activity, while the brain worker may need physical recreation. Uniform observance of Sunday will then not provide uniform rest. Individual efficiency must thus often be secured by following individually different methods.

Amusements

Individual differences may be expected to express themselves in amusements and avocations as well as in other fields. And in this field where there is considerable freedom of choice, there is a wide diversity of preferences. Each of a variety of athletic contests and sports has its own special group of enthusiasts. Indoor games exist in many forms, and cards even may be played in almost numberless ways. Circuses, moving pictures, the legitimate stage, opera, concerts, and many others supply amusement and recreation to satisfy different tastes and desires. In the field of literature we find the greatest range of content and quality. The success of these enterprises is sufficient testimony to the absence of uniformity in human nature.

But in spite of divergences there are at the same time similarities to such an extent that it has been possible at various times to collect enormous crowds to observe the same spectacle, as, for example, a prize fight, a bull fight, a gladiatorial exhibit, or the parade of an army returning victorious from war.

To be popular an amusement must make an appeal that will reach the masses of the population. If the appeal is to fundamental instincts such as pugnacity or sex, a large crowd may be expected, because nearly all individuals are subject to such stimuli. But if the appeal depends on a high order of intellectual or æsthetic development, the crowd will be absent.

The foregoing has an important bearing on the question often discussed these days as to whether our national taste in literature, in music, in dancing, in moving pictures, etc.,

is degenerating. In the first place it is undoubtedly true that more people are reading today than ever before, because of the wider spread ability to read and the greater supply of inexpensive material to read. In the next place it is probably true that a large part of the material written for public consumption is written by authors who are largely dependent on income from their writing, or if not actually dependent on such income are at least much influenced by it. Such being the case, it would quite naturally follow that they would write for the larger public, and this would mean writing for a public of a lower average intelligence than the reading public of several generations ago. We should then expect that the mass of our contemporary literature would compare unfavorably with the classics handed down to us. Whether this popularization of literature is so general as to prevent the production of masterpieces equal to those of former days is not so easy to say. This will have to be left for later generations to decide.

Moving pictures, like fiction, have come in for considerable condemnation on the score that they show degenerating tastes. That they show, in many cases at least, degenerate tastes cannot be denied; but that they show degenerating tastes is more questionable. Many people will attend moving pictures who will not read, because the language of pictures is universal. Pictures appeal to the illiterate and to those only slightly literate and to the literate who do not like to read. This enormously increases the range of the population who can and do enjoy pictures in comparison with those who read, and this naturally means a corresponding lowering in the average of the intelligence of those who attend moving-picture shows. And if the intelligence of moving-picture crowds is lower than the intelligence of readers, it naturally follows that many films of low quality will be popular. In practice, of course, we find moving-picture houses of many grades: some are very good, many

are of average quality, and some are exceptionally poor; but the general average is likely to be low. And if one accepts what seems to be the truth about the average level of intelligence of the general population, it is hardly to be expected that so popular an institution as the moving pictures can be kept at a much higher level than the present. Reformers will protest at such a conclusion, but the evidence is against them.

In recent years dancing has received criticism similar to that directed against fiction and moving pictures. It is interesting to note, however, that the lowering in the standards of dancing and of dance music corresponded rather closely with the degree of public participation. As the dances began to drift from the staid and the sedate, an increasing number of the public became interested. Other factors have probably been involved, but it will be recalled that this particular movement began before the War and so cannot be given that ready explanation. One, at least, of the important factors is the relation between the degree of public participation and the level of dancing.

If one will discard poetical and theological conceptions of man and content himself with a realistic description of men as he finds them in actual life, it will not be difficult to understand that many of our present problems are the result of increased participation in activities by the general public as a result of our economic development with the shortening of hours of labor and the increased luxury and raising of standards of living. The average citizen and the citizen below the average now have the time and the money to enjoy things which heretofore they could not hope to achieve. Our natural tendency has been to think that such resulted only in the improvement of the citizens in question. It has also been true, however, that the level of the activities in which the public have engaged to an increasing extent has been lowered.

Individual Differences in Religion

The history of religions is a history of conflicts, of bitter controversies, of persecutions, of inquisitions, and of prolonged and bloody wars. Some of the most horrible deeds recorded in human history have been committed in the name of religion. This fact puzzles many good people who think of brotherly love and religion as more or less synonymous terms. But religion and brotherly love are by no means necessarily synonymous. Abandoning the theological aspect of the matter, it will be more convenient here to say that every man is religious and that his religion consists of the things he prizes most. A sect or religion will then contain a group of people who to a considerable extent agree on certain things as being of great importance. Since there are many differences in human nature, it is natural that there should be many creeds; the real wonder is that there are not more.

As beliefs that are considered a part of religion are invested with a supernatural and divinely authorized character, it is but natural that they should be the most irrationally and fanatically held of all possible beliefs. Let then these beliefs be questioned or attacked and the individuals supporting them react all the more violently because of the importance attached to the belief. When our minor beliefs are attacked we can be relatively complacent; but when an attack is made on the things we hold to most strongly, the things we consider most important, a violent reaction is probable. So when different religions have met, each has denied the other and predicted for its adherents a warm future. The interchange of such compliments is rarely conducive to brotherly love, and since each regards the other as representing the spirit of evil, each feels called upon to strike a blow of religious indignation.

Identical twins appear to be about the only people who agree in any detail. It is, then, inevitable that there will be

about as many sets of values as there are individuals and that native disposition and environment acting together will cause them to form numerous religious groups. The unfortunate part of it is not that one creed limits its meat diet on Friday to fish while another abstains entirely from pork, or that one sect practices total immersion of adults while another sprinkles a little water on the heads of infants; the fact that these differences in beliefs and in practices exist would not be so important if it were not for the militant advocacy of them and the attempt to convert or to exterminate dissenters. Human nature cannot be standardized in religious matters any more than in height, weight, color, disposition, or intelligence. Tolerance is therefore needed in religion above all other things. Merely because we prefer one belief to another is by no means an adequate justification for attempting to cast all others in the same mold in which we were cast. Mankind has the choice between strife and tolerance. A study of individual differences and of the historical experience of the race should lead to less of the former and more of the latter; for it is quite evident that uniformity in belief is impossible.

Individual differences in religion are reflected by the conceptions of God and of the future life held by different peoples and by the same peoples at different stages of development. The character of the god worshiped depended on the character of the people. Similarly the future life was pictured in terms of their favorite activities. The American Indians thought of the next world as a happy hunting ground, the Norsemen as a place for feasting and boasting, the Mohammedans as a place for licentious living, etc. The Jews with their interest in commerce would not have cared especially for the heaven of the Indians; neither would the Indians have been happy in a hunting ground paved with gold, silver, and precious stones.

Fallacious classification into types is well illustrated by

the contemporary practice on the part of many sects of dividing mankind into two widely separated groups: the saints and the sinners, or the saved and the damned. Theological bias aside, no exhaustive study of the matter is necessary to show that there are many degrees of goodness and that even the saints are not all good and that the sinners are not without their good qualities. If we had an adequate measuring scale for goodness or saintliness or sinfulness, there is every reason to believe that the results would show the population to be distributed according to the normal probability curve and not separated into two widely different groups.

Marriage and Related Problems

Marriage as a Social Institution.—Biologically considered the purpose of marriage is the perpetuation of the species. This is fundamental, and any discussion of marriage should always proceed with a clear recognition of this basic fact. In all higher animals this process of perpetuating the species requires two parents of unlike sex. Biparental reproduction has two distinct advantages: it makes for greater variability in the young and it makes possible a most advantageous specialization in the activities of the parents. Since the female has to bear the young and suckle them in the case of the mammals the male is released for other activities. In man this has made possible the development of a complex civilization. The activities of the male and the female here are distinctly complementary: both are essential for the welfare of the child.

While the biological purpose of mating is reproduction, it is more immediately the outgrowth of sex attraction, and marriages may and do take place without much thought of the consequences. Generally, it is true, with the appearance of children, if not before, the parental instincts express themselves, and in the average case a very large part of the effort

of the parents is guided by the desire for the welfare of the children. And on the higher levels of civilization a most important function of the family is to provide for the proper training of the children. To this is added the stimulus for the parents to provide as well as possible for the children's economic futures. Over and above the biological functions of the family we find that it has important social and psychological functions. It may provide physical, social, and intellectual companionship. In case of more intelligent individuals the social and intellectual aspects of marriage are of tremendous importance—so much so in fact that we frequently find marriages where, because of age or other factors, the bearing of children is a recognized impossibility. And in cases where such an impossibility does not exist, it is none the less clear at times that neither sex attraction nor the desire for children is the real reason for the marriage. We should, therefore, recognize the essential complexity of the marriage relationship among highly civilized peoples.

Marriage Customs.—Among barbarians marriage is often by capture. The roving male takes by force any female he is able and cares to take. With a more stable social order purchase takes the place of capture: a wife will cost so many cattle or other articles of commerce. In many cases the arrangement of marriages becomes an affair of trading between the parents without either the advice or the consent of the principals most concerned. To a considerable degree this practice still prevails in some civilized countries, though naturally the principals have more to say on the matter. The marriage of convenience, dictated by social and economic considerations, but arranged more largely by the man and woman concerned, is found in all civilized countries. In contrast to this calm arrangement of marriages we have, especially in America, the marriage from romantic love. Social and prudential considerations

are often cast to the winds and couples marry on slight acquaintance simply because at the time each feels a passion for the other. In still other cases naturally we find a mingling of these various elements.

Intelligent Marriage Selection.—To marry intelligently is to marry with due consideration given to the many complex relationships involved in marriage. In general it seems safe to say that people of similar intelligence levels, of similar religious views, of similar tastes and desires and ambitions will be better companions than will those of contrasting or antagonistic traits. There is no scientific foundation for the popular idea that opposites attract, except in the matter of sex itself. Due to the complexity of human nature it is perhaps inevitable that in some respects any couple will be very different, and this need not be a matter of importance provided the point of difference is not one which is of grave concern to either person. To avoid differences on vital matters is the important problem. Only when two people understand each other before marriage and are in agreement on all important matters and have similar tastes and interests can harmony be expected. For this reason later marriage has often been advised, and up to a certain point the argument is sound. The wisdom of this is, however, to be questioned on other grounds. The older two people are, the less adaptable they are; and even under the best of conditions considerable adaptation is necessary, since all interests and attitudes are never the same. Younger couples will find such adaptation easier, older ones may find it impossible.

Divorce.—If social conflict is based on differences, it is evident that divorce as a specific form of conflict must be based on differences between the persons involved. Nor will any person familiar with many cases of divorce deny this. The remedy for divorce must consist then in removing this cause. Since character is pretty well fixed before marriage,

it is evident that the solution of the divorce problem must lie in wiser marriage selection.

The causes given in court for divorce are various: the real cause is generally the same—incompatibility. Adequate legal grounds for divorce not infrequently exist but without any attempt to secure a divorce, while in other cases where no legal ground exists it is often deliberately supplied if the two people are sufficiently incompatible. The problem of divorce becomes then the problem of preventing the marriage of unlike individuals. What can be done in this direction? Wiser marriage laws will be suggested by many. It may well be doubted, however, just how much can be done by this method. Education of the right kind might be expected to be of considerable value, but at present practically nothing is being done in that direction. Intelligent guidance on the part of parents is the thing most to be desired, but too often the parents make no positive contribution whatever towards helping their children in this direction. At the risk of shocking the romantic reader the writer ventures to suggest that in some respects the problem is not unlike that of employment psychology and the time may yet come when scientific methods and measurements will be called in to help in doing what instinct and chance have so often failed to succeed in doing. For the present, however, the most we can do is to encourage frankness and a full understanding before marriage so that there will be less cause for the development of differences later.

Conflicts between Young and Old

One of the conflicts which is ever present with us is that between the young and the old. Differences in age are accompanied by differences in point of view, and the lack of understanding of the basis of the conflict often results in unnecessary hostility between the two groups. As far

as mental capacity is concerned, the young man of 20 has as much intelligence as the man of 50 and there is some reason to believe that in solving new difficulties the younger man is the better of the two. Naturally, however, the older man is supplied with more prepared judgments and solutions and so within the field of his experience is more fitted to deal with problems than the younger man of the same original capacity. Older men have more fixed habits of thought and action, younger men are more flexible and adaptable. The stability of institutions is secured, therefore, by entrusting them to older men. Change is secured by entrusting them to younger men, though change is simply digression and may be either progressive or regressive or neither: it may be nothing more than a change as one fashion follows another, neither being necessarily better than the other.

In so far as conflicts are due to the changing conditions of social environment, it is inevitable that they should occur. It is unreasonable to expect that boys and girls reared in the days of motor cars, movies, and radio should see things from quite the same angle as do their parents reared in a different environment. The perspective of youth is inevitably quite different from that of age and so conflict between the two can only be avoided by an attempt at an intelligent understanding of differences. The responsibility for this must rest primarily on the mature and the aged rather than on the young. The lessening of conflict in this direction can only come through the recognition on the part of the old that times change and that the ideas and attitudes of their youth will require frequent revision. Parents have a very great obligation to their children in this direction.

Social Differentiation and Disintegration

In earlier chapters we have discussed the process by which society becomes differentiated into social groups

with different levels of intelligence and different interests. Within certain limits this makes for industrial efficiency and social progress and so contributes to individual happiness. This social differentiation may be compared to the differentiation of cells in the higher animals which has made these animals more efficient. In the animal, however, greater efficiency through differentiation has, it would seem, been bought at the price of death. The simple protozoan apparently is potentially immortal: the complex metazoan matures, becomes senile, and dies.

Social philosophers may well ponder the question as to whether the process of social differentiation will eventually lead to the same termination. Of course the analogy may not hold. It does appear to be true, though, that the sharper differentiation into classes has led to increased hostility between classes. Capital and labor today have more troubles than they had when employer and employee worked in the same shop together. Is it too much to hope that with a sharper drawing of class lines the same degree of social solidarity can be preserved?

The loss in social solidarity is accentuated by the splitting of the church into a multitude of sects. Among primitive peoples there is one and only one religion. However objectionable this may be on some grounds, it has a tremendous advantage in preserving a group consciousness and group loyalty. One of the most important normal functions of religion is to curb excessive individualism and to promote a broad social consciousness. When, therefore, religious sects become too highly differentiated, *i.e.*, individualized, they have to that extent lost one of their chief functions. Associated with the development of social differentiation in case of religious sects is the fact that a large group in society ceases to be members of any religious group—a condition which could not exist among primitive peoples. As a result of this many individuals are not

greatly influenced by the best of the *mores* and ideals of the group. This facilitates the development of many anti-social tendencies and movements. It leads to an increase in crime.

Some students hold that the collapse of Greece and Rome and of some later states as well has been due more to loss of morale and to internal disintegration than to external foes. In any case the problem deserves our serious consideration. There are undeniably some dangers associated with great social differentiation. Hence it is worth our while to consider what measures are necessary in order to preserve the group loyalty without which no nation can long survive.

Individual Psychology and the Interpretation of History

History is a story of conflict and often of progress. The conflicts, as we have already seen, have in large measure been the result of individual differences. One race wars against another, one tribe against another tribe, one creed against another creed, one political party against another, one ruler against another, and so on, *ad infinitum*. Such conflicts have frequently involved much suffering, but they have frequently led to a broadening of the mental horizons of the fighters. Such was true in the crusades: the Christian soldiers fighting the Turks lost much of the provincialism and narrowness with which they started the campaign. Such was the result of the American Army's visit to Europe: those who returned, returned with a broader outlook. Such has been the result of the conflict between Protestantism and Catholicism: a more charitable attitude is now manifested by both. Such even has been the result of the conflict between science and religion: both have lost some of their dogmatism: both have realized to a greater degree their own limitations. In the economic field, conflict between "old ideas" and "new ideas" and between old

and new ideals, methods, and machines likewise leads to progress.

In the history of thought extreme individuals have extreme views and so develop such rival philosophies as Stoicism and Epicureanism, materialism and spiritualism, rationalism and empiricism, dogmatism and agnosticism, or in literature such schools as the realists and the romanticists.

Some of these differences are apparently inherent in human nature and may be expected to continue. Today, for example, the disciples of Plato and those of Democritus carry on the philosophical war started more than two thousand years ago. At least in the field of science, however, it seems possible to terminate most conflicts. But even here we find marked limitations when we turn from the experts to the masses. The astronomers are unanimously agreed that the earth is not flat and that it does not have four corners, but the masses are not yet agreed. To a great extent questions of fact can be settled by scientific methods, and the world is slowly learning to respect scientific findings and to substitute them for individual opinions; but in the fields where tastes, desires, emotions, and opinions rule, differences appear to be the law of nature, and we are led again to the ancient maxim: *De gustibus non disputandum* —(we ought not to dispute about matters of taste).

What bearing does all this have on the question of universal peace? Apparently it leads us to the conclusion that universal peace will be secured only when all men are alike, when all human beings are of one age, one sex, one race, one heredity, and one environment. Clearly we are speaking not of this world.

Progress and conflict appear to be inseparable. The introduction of the automobile aroused violent antagonism from some. The introduction of labor-saving machinery has often been received with hostility by the laboring classes who feared being thrown out of employment. New knowl-

edge is received with more or less hostility even, as witness the Copernican system of astronomy and the principle of evolution. If progress depends largely on conflict, it would appear that individual differences cause much of our progress. Conflict stimulates thought, and thinking leads oftentimes to improvements.

While conflict has often been beneficial, there can be no question that its benefits have often been bought at too great a price. And especially is this true when they could have been secured by more rational methods. The more limited one's training and experience, the narrower are his prejudices and the more likely his convictions are to run counter to the truth or to the most intelligent opinion. The wider a man's training and experience, the more he is able to see his own limitations and the more tolerant he becomes of others. Tolerance is never based very firmly on ignorance. A knowledge and understanding of individual differences plus a respect and feeling of kindness for all human beings is the best basis for the development of tolerance. If education can contribute to a wider understanding of the extent and character of individual differences, it can do much to increase tolerance and so decrease violent conflict. Conflict will in any case persist, but it can be at once more rational and more humane, and if it becomes so, it will lead to greater progress of the race. That this is true is demonstrated by history. Modern history is a history of decreased autocracy, of increased tolerance and respect for individuality, and of increased progress in the advance of civilization.

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